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The Pharmacist Supply in the United States, 1994-2009: A Population Ecology Perspective

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Abstract

THE PHARMACIST SUPPLY IN THE UNITED STATES, 1994-2009:
A POPULATION ECOLOGY PERSPECTIVE

By Kevin Shawn Joseph Lett

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Major Director: Director: Dr. Michael A. Pyles

The U.S. healthcare system is a complex segment of our society that is constantly evolving with changes to various areas such as education, financing, safety, and health. There continues to be a critical examination of how healthcare professionals are trained and utilized as healthcare demands increase. One category of healthcare professionals that has evolved over time to address societal needs is pharmacists. Pharmacists have kept their traditional function of dispensing medications while expanding into multiple areas of expertise and training from patient counseling and drug therapy, to being part of multidisciplinary teams treating acute care patients.

According to the National Association of Boards of Pharmacy (NABP) in 2009 there were approximately 265,000 licensed pharmacists in the U.S. (NABP, 2010). The Health Resources and Services Administration (HRSA) reported the settings with the largest number of positions are chain pharmacies (77,300), hospitals (49,200), and independent pharmacies (36,200) (DHHS, 2008).

The ratio of pharmacists per 100,000 population is expected to increase from 68.9 pharmacists per 100,000 population to 76.7 per 100,000 between 1995 and 2020 (Gershon, Cultice, & Knapp, 2000). This increase in the pharmacist to population ratio is consistent with a growth rate of 13% during this time period of time.

Until 1998, the supply of pharmacists in the U.S. appeared to be in reasonable balance with demand. Market forces gradually upset the delicate balance between the supply of pharmacists and the demand for their services between 1998 and 2009. In particular, a precipitous increase in the volume of prescription written and filled during this time period contributed to upsetting this delicate balance between the supply of pharmacists and demand (Cooksey, Walton, Stankewicz, & Knapp, 2003).

Researchers have noted a number of environmental factors affecting the pharmacist supply in the U. S. This inquiry explores these factors within the context of the population ecology theoretical framework. In addition to the volume of prescriptions, additional environmental factors believed to have a discernible impact on the pharmacist supply include, the number of physicians, size of the business industry and insurance coverage. Previous studies on pharmacists supply have pointed to income, physician population, and population among other variables that predict the demand for pharmacists (Walton, Cooksey, Knapp, Quist, & Miller, 2004; Cherry, D.K., Woodwell, D.A., & Rechtsteiner 2007; Walton, Knapp, Miller, & Schumock 2007). U. S. physicians wrote over 4 billion prescriptions in 2007 (Medical Expenditure Panel Survey, 2008). Physicians are the primary healthcare providers that generate prescriptions to be filled. Consequently, the number of physicians is believed to be a significant environmental factor affecting the supply of pharmacists.

There were approximately 940,000 physicians in the U. S. in 2008. Projections call for continuous growth of the number of physicians well into the future (Smart, 2010). Another important environmental factor potentially impacting the demand for pharmacists is the size of the business industry. In 2006, the health plan offer rate for large or medium organizations (50 or more employees) was 96.7% compared to 61.2% for small organizations (50 or less employees) (Sommers & Crimmel, 2008; Crimmel & Sommers, 2008).

Insurance coverage has the potential to have a positive impact on the demand for pharmacists because it provides the opportunity to obtain required prescriptions (Ranji, Wyn, Salganicoff, & Yu, 2007; Weinick, Byron, & Bierman, 2005). The population ecology theoretical framework has been used in the study of restaurants, newspapers, and physicians and their interactions with their surrounding environments. The theoretical framework proved to be beneficial in the exploration of the pharmacist supply vis-á-vis the environment. The primary constructs in the population ecology theory are carrying capacity and density. Carrying capacity consists of two sub-constructs: munificence and concentration. Density points to the current pharmacists supply and its impact on the future pharmacist supply.

Numerous variables have been used in previous empirical studies of the pharmacist supply. Among the indicators of munificence in previous studies in the extant literature on pharmacist supply are total population, elderly population, hospitals, and median household income. In the present inquiry, total population was found to be a statistically significant environmental factor affecting the pharmacist supply. This was hypothesized that there is a positive linear relationship between total population and the pharmacist supply.

The number of hospitals with pharmacies was also found to be a statistically significant environmental factor affecting the pharmacist supply. Hospital pharmacies are important venues wherein pharmacists can demonstrate their unique expertise and make discernible contributions to desirable health care outcomes when pharmaceutical interventions are required. In light of this empirical finding, it seems reasonable that a growth in hospital pharmacies corresponds with an increased demand for pharmacists (Kaboli, Hoth, McClimon, & Schnipper, 2006).

Measures of the concentration dimension included the number of hospital beds per 100,000 population, employer volume and size and the number of insured. The only putative indicator of concentration that was found to be statistically significant in this inquiry was the number of employers with 20 or more employees. Previous pharmacist supply was found to be a significant environmental factor affecting the pharmacist supply in the future. Thus, density is a significant environmental factor affecting the pharmacist supply. Five of the 13 hypotheses tested in this inquiry were accepted. These findings are consistent with related findings in the extant literature on the pharmacist supply.

Empirical findings from this inquiry are believed to make significant contributions to the literature on the pharmacist supply. The population ecology theoretical framework appears to be a suitable tool for exploring environmental factors affecting the pharmacist supply. Recommendations for future research are presented in the final chapter.

Chapter 1: Introduction

Background on Pharmacist Supply

The pharmacist supply continues to be one of great interest in a dynamic healthcare environment faced with increasing demand to fill a high volume of prescriptions for pharmaceuticals in addition to the infusion of multiple roles and responsibilities. Pharmacist supply represents the third largest health professional group in the U.S. with approximately 265,000 active pharmacists in 2009 (NABP, 2010). The pharmacist supply has received significant attention over the past two decades. In December 1999, the United States Congress directed the Secretary of Health and Human Services to conduct a study on the potential shortage of licensed pharmacists (Department of Health and Human Services [DHHS], 2000). The Health Resources and Services Administration (HRSA) reported the settings with the largest number of positions are chain pharmacies (77,300), hospitals (49,200), and independent pharmacies (36,200) (DHHS, 2008).

Synopsis of Pharmacist Demand

While the pharmacist supply is increasing, there are multiple factors that can affect pharmacist supply levels. One factor is the increased use of prescription medications.

From 1997 to 2004, the number of prescriptions purchased increased by approximately one billion (Stagnitti, 2007). There is no projection for the number of drugs being prescribed or dispensed subsiding in the near future.

Physicians are the primary healthcare professionals who write prescriptions filled by pharmacists. An increase in prescription volume will lead to an increase in work volume and a potential need for pharmacists. The number of physicians in the U.S. was approximately 940,000 in 2008 with projections for continuous growth well into the future (Smart, 2010). In 2005 there were approximately 963 million physician office visits in the U.S. and over 679 million of those visits resulted in medication being provided or prescribed by a physician (Cherry, Woodwell, & Rechtsteiner, 2007). Undoubtedly, for an increase in office visits and medications prescribed to patients to occur, there more than likely has been a gateway developed to attain care. The increased access to healthcare through insurance coverage has created this gateway. In 1995 the over 65 population accounted for 24% of all physician office visits; this percentage increased to 26% by 2005 (Cherry, Woodwell, & Rechtsteiner, 2007). The implementation of Medicare Part D in 2006 allowed additional older Americans to receive medication benefits. The Centers for Medicare & Medicaid Services (CMS) estimated in 2004 that 15 million of the 40 million Americans eligible for Medicare had no prescription drug coverage (Reissman, 2004).

Implementation of Part D of Medicare could potentially help make 14 to 30 million prescriptions available to persons who may not have been able to afford their prescription drugs previously (Reissman, 2004). The ability for one to afford prescriptions is an important driving force in the needed supply of pharmacists. As noted by Reed (2005), approximately 51% of uninsured working adults surveyed did not purchase a prescription compared to 14% and 31.5% of working adults who have private and public insurance, respectively.

In addition to Medicare Part D, the Patient Protection and Affordable Care Act is estimated to give 32 million previously uninsured Americans insurance coverage (Stefanacci & Spivack, 2010). This influx is projected to significantly increase prescription drug use (Matzke & Ross, 2010). Thus, the demand for traditional pharmacist services will rise as these new provisions take effect. The volume of prescriptions has the ability to increase substantially in communities that can afford their medications. Communities have a strong desire to retain their pharmacists because these individuals provide expert health advice, provide prescriptions, while serving either formally or informally as health educators, thereby improving the community's public health (Manasse & Speedie, 2007).

In addition to an analysis of the insured and prescribers, there are the facilities in which pharmacists provide their services. The increase in the number of pharmacy facilities may also be an important predictor in reviewing the pharmacists supply. The number of pharmacy chain drug stores has increased from approximately 51,000 in 1997 to approximately 56,000 in 2007 (NACDS, 2007). In conjunction with community pharmacies is the infrastructure for dispensing and distributing prescription medications. These infrastructures consist of nearly 6,000 U.S, hospitals, mail order pharmacies and foreign sources for obtaining prescription medications (Manasse & Speedie, 2007).

Studies on Pharmacist Supply and Limitations

A number of studies have pointed to the importance of examining the pharmacist supply and have done so utilizing varying timeframes and variables. Walton, Cooksey, Knapp, Quist, and Miller (2004) have examined the impact of supply and demand factors on filled pharmacist positions. They reported that after controlling for population, the number of filled pharmacy positions was significantly correlated with prescriptions, hospital days, pharmacies, and residents older than 65 years. Although not addressed in the Walton et al. (2004) study, Cherry et al. (2007) reported that demand can be affected by the supply of physicians in a state.

A second study by Walton and his colleagues 2007 examined the relationship between demographic and economic variables in their attempt to understand variations in the pharmacist supply in America. Walton and his colleagues found that surrounding population size, community income levels, and the number of healthcare facilities all play a role in the future size of the pharmacist workforce. These results concurred with some of the evidence found in his previous study in 2004.

Findings from extant studies on pharmacy supply in the literature, provides some insight into the relationship among environmental factors that may impact the pharmacist supply in America (Knapp, 1999; Manasse & Speedie, 2007; Burt 2002; Meissner et al., 2006; & Sommers, 2004, Mott et al., 2006; & Knapp et al, 2005). An examination of pharmacist practice environment allows researchers, policy makers and healthcare administrators an opportunity ability to assess the demand for pharmacy services and address current local needs (American Society of Health System Pharmacists [ASHP], 2007).

Conceptual Framework.

The theoretical framework for this inquiry is that of the population ecology. This theoretical framework is conducive to an exploration of the pharmacist supply and considers the environment. The population ecology theoretical framework has been utilized to study restaurants, newspapers, and physicians and their interactions with their surrounding environment (Freeman & Hannan, 1983; Carroll, 1984; Jiang & Begun, 2002), and is based on Darwin's Theory of Evolution.

Darwin's Theory of Evolution looked at growth and decline among species while accounting for environmental factors (Darwin, 1859). Darwin dismissed any premise that a population's evolution could be attributed to a predetermined developmental trend (Bowler, 2009). Many theorists have concurred with Darwin's assessment that environmental forces produce and shape populations that occupy and flourish in a particular geographical setting.

The selection of the population ecology theory was based upon its emphasis on organization-environment relationships (Hannan & Freeman, 1977). Population ecologists view the environment as a resource, which aids in the continued viability of populations and communities. This perspective recognizes much of the ongoing change within health services as a function of necessity to better fit the environment (Hurley & Kaluzny, 1987). Using the population ecology theoretical framework allows focus on two major mechanisms to evaluate the growth and decline of the pharmacist supply: the environment's carrying capacity and population density.

The environment's carrying capacity for the pharmacist population consists of munificence, which refers to quantity of resources such as the physician population, pharmacy facilities, and prescription volume; and concentration, which refers to the geographical concentration of resources in specified vicinity such as hospital beds per 100,000 population, pharmacies per 100,000 population, and number of insured. The second major mechanism for evaluating the growth and decline of the pharmacist supply is population density. Population density refers to the current pharmacists' supply impact on the future growth of the pharmacist supply. As the pharmacist supply increases it affects the carrying capacity for pharmacist services of an area, which in turn may lead to a decrease in the growth rate of the future pharmacists supply due the inability to support too many pharmacists. In this inquiry there will be an investigation of the pharmacist supply and its interaction with the environment within the context of the population ecology theoretical framework. This theoretical framework lends itself to a longitudinal research design such as the one developed in this inquiry. Gaining an understanding of the demographic changes that influence the pharmacist supply may help identify ways to increase staff recruitment and retention, while addressing a host of additional healthcare issues in the community.

Research Questions.

The conceptual framework for this inquiry will provide the ability to seek empirically based answers to two broad research questions.

1. What are the environmental factors that influence the number of pharmacists in the United States?
2. Does the past number of pharmacists impact the current and future number of pharmacists?

Significance of the Study

This study will provide beneficial information about environmental dimensions of the United States and its impact on the pharmacist supply change over time. Variables such as the pharmacies, hospitals, physicians, prescriptions filled, insurance coverage, wealth, and businesses all bring a different dynamic to this inquiry.

Physicians are primarily responsible for the volume of prescriptions written; therefore, it is important to gauge their supply vis-à-vis the pharmacist supply. While having the medical personnel available is important to prescribe medications, the ability to pay for the prescriptions is equally as important. The ability to pay for ones medication through either personal wealth or health insurance that is primarily provided by an employer/business aide in determining the volume of prescriptions a pharmacy and pharmacists are tasked with filling.

Pharmacists fill prescriptions in numerous types of pharmacy work settings. Some pharmacists may choose to work in a chain pharmacy or hospital based upon the ability to make more money. In one survey hospital CEO's describe their frustration and stress induced by their continuing difficulty in filling pharmacist's positions within their hospitals (AMN, 2009).

This inquiry provides the effects of environmental factors on the pharmacist supply and will be useful for hospital administrators and pharmacy employers as they develop their strategic plans for recruitment and retention of pharmacists. There have been numerous studies on the pharmacist supply in relation to segments of the environment; however, there are limited studies that reviewed the pharmacist supply on a yearly basis and none utilizing this length of time. This study measured the change in the pharmacist supply over time, while accounting for a myriad of environmental factors.

Summary of Findings

The pharmacist supply was measured overtime to attain an understanding of the environments impact on its level of growth. There were 13 hypotheses tested with five of the hypotheses results being statistically significant. The population and hospitals were the only two variables found to be statistically significant while measuring munificence. Employers with 20 or more employees and the number of insured were also found to be statistically significant when

measuring concentration. The last hypothesis on pharmacist supply displayed the ability to consistently grow when accounting for the previous year growth in pharmacist supply.
The empirical evidence found in these hypotheses was corroborated by multiple studies and will be discussed in more detail in the following chapters.

Implications

The population ecology theoretical framework proved to be useful in the study of the pharmacist supply. There are several implications from this inquiry one would be on the insured population which was proven to have a significant positive linear relationship with the pharmacist supply. Couple this result with an increase in utilization and workload with the introduction of the Healthcare Reform Act and you have a state of affairs that can considerably impact the pharmacist supply. The inclusion of 32 million previously uninsured people receiving insurance coverage could significantly change the pharmacist workforce landscape.

It is of the essence that healthcare players determine what the local market forces are that impact their ability to determine their pharmacist manpower needs. Some of the questions that can help determine and form their strategic goals/plans are: how many pharmacists are needed at my hospital and will it improve the quality of care in the community? Is the number of pharmacists in my community sufficient to address the number of insured and physicians in the geographical area? Evaluating one's environmental needs will help to ensure that a practical plan is developed. This should help to guarantee that an appropriate number of pharmacists are available to meet the current and changing demands of their surrounding environment.

Outline of the Remaining Chapters

Chapter 2 will provide an overview of the literature on the number of pharmacists in the United States. Chapter 3 provides an overview of the theoretical framework for this inquiry as well as the hypotheses to be tested. Chapter 4 presents the research design, variables and statistical methods used to test the hypotheses presented in Chapter 3. Chapter 5 provides the results of the analysis which include the descriptive statistics, and the repeated measures regression analysis. Chapter 6 presents interpretations of each hypothesis, in addition to implications for various entities. The chapter concludes with the limitations of the study and suggestions for future research.

Chapter 2: Literature Review

In this chapter, a review of the literature regarding the role of pharmacists in the healthcare system and factors affecting the supply and demand of pharmacists in the United States are delineated. Factors that have changed in the healthcare arena that impact the dynamics associated with the pharmacist supply and demand are discussed and a general statement of the problem to be addressed in this study is presented.

Importance of Pharmacists for the United States Healthcare System

Pharmacists serve in varying roles in the US healthcare system. They distribute drugs prescribed by physicians and other health practitioners and provide information to patients about medications and their use. They interact with physicians, patients and the staff of healthcare facilities. Pharmacists in the US dispense over 3.6 billion prescriptions per year (DHHS, 2008).

Pharmacists who practice in clinical settings such as hospitals, clinics, and nursing homes are called clinical pharmacists. Other settings in which pharmacists practice include the managed care industry and the pharmaceutical research industry. The American College of Clinical Pharmacy (ACCP) defines clinical pharmacists as pharmacists that care for patients in all healthcare settings (American College of Clinical Pharmacy [ACCP], 2008). The proportion of U.S. pharmacists working in traditional community pharmacy practice settings (independent, chain, mass merchandiser, and supermarket pharmacies) remained relatively stable between 2000 (55.4%) and 2004 (56.4%) (Beardy et al., 2004).

Some other areas in which pharmacists' skills are being used to improve the medication use process include medication therapy management, pharmaceutical care, drug-use review, drug-use management, disease management, and pharmacy benefit management (Schommer, Sogol, and Brown, 2007). Outside of being directly involved with the discovery and testing of new pharmaceutical agents, pharmacists may also work as medication sales representatives or consultants for managed care organizations. Hospital pharmacists work in hospitals, and hospital outpatient settings such as clinics, and nursing homes and they advise medical staff on the selection of appropriate drugs and optimal dosing. Hospital pharmacists may also be involved in activities related to monitoring drug levels for patients in the hospital, teaching, supervising pharmacy interns and residents and conducting research. The proportion of pharmacists in governmental and nongovernmental hospital settings remained stable between 2000 and 2004, 24.0% and 24.7%, respectively (Berardi et al., 2004). In 2001, U.S. hospitals reported nearly 2 billion drug orders for hospital in-patients (Knapp, 2002). This statistic is important in light of the fact that 75% of the pharmacists surveyed reported entering over 90% of the medication orders in hospitals and health systems through utilization of electronic order entry (Ringold, Santell, & Schneider, 2000).

According to the National Association of Boards of Pharmacy (NABP) in 2009 there were approximately 265,000 licensed pharmacists in the United States (NABP, 2010). The Health Resources and Services Administration (HRSA) reported the settings with the largest number of positions are chain pharmacies (77,300), hospitals (49,200), and independent pharmacies (36,200) (DHHS, 2008). Pharmacists play a vital role in maintaining the quality of system by providing their patients with valuable information on the safe and proper handling of prescription and over-the-counter medications.

Pharmacists are the primary source of scientifically valid information and advice on the best use of medications. They are uniquely positioned within the healthcare system to deliver objective, evidence-based therapeutic information and recommendations to assist their patients in achieving optimal pharmacotherapeutic outcomes. This expertise entails offering recommendations that include both traditional and nontraditional therapies and medications (ACCP, 2008). Another vital function performed by pharmacists involves monitoring for potential interactions of the medications being taken by a patient.

A study by Bond, Raehl, and Franke (1999) pointed to the importance of clinical pharmacists in maintaining the quality of patient care in hospitals. This study utilized Medicare Hospital Mortality Information Data and the National Clinical Pharmacy Services (NCPS) database provided by the Centers for Medicare and Medicaid Services (CMS) (formerly the Healthcare Financing Administration; (HCFA). In the aforementioned study the authors reported that overall there were 44.15 fewer deaths per year, per hospital in hospitals that had pharmacist-provided drug information services compared to those that did not. Put another way, these authors found that there were 10,463 fewer deaths per year in the 237 hospitals in which pharmacists provided drug information services. This study clearly illustrates the vital role of pharmacists in the U.S. healthcare system; especially in hospital settings. The consistent and effective use of pharmacists in hospitals can reduce mortality in hospitals and contribute to eliminating or reducing unnecessary medication incidents. Medication dispensing and distribution practices affect safe medication administration (Pederson, Schneider, & Scheckelhoff, 2009). Thus, pharmacists play a key role in safe medication use. MacLaren and Bond (2009) found that mortality rates in patients with thromboembolic or infarction-related events only and thromboembolic or infarction-related events with bleeding complications were higher by 37% and 31%, respectively, in ICUs without clinical pharmacy services when compared to ICUs with clinical pharmacy services. The lengths of ICU stay were also longer in ICUs without clinical pharmacy services.

MacLaren and Bond also reported a significant economic impact of not providing clinical pharmacy services in ICUs. Based on their analysis, excess charges to Medicare ranged from $63,175,725 to $215,397,354; depending on the presence of complications. These figures do not include the additional realized drug charges, which also increase without pharmacist services being present. Although their study was limited to a specific in-hospital setting, it was concluded that care provided by intensive care pharmacists enhance clinical and economic outcomes of critically ill patients. This was reaffirmed by additional studies measuring effectiveness of pharmacists in intensive care settings. It may be plausible to speculate that the addition of pharmacists to varying settings may help with the clinical and economic outcomes of patients.

In a study of pharmacist review of medication orders in the Emergency Room (ER), Brown et al. (2008) utilized retrospective chart review to investigate the frequency of medication errors in an emergency department (ED) before and after an ED pharmacist was assigned to check medication orders. They reported that the rate of errors was 66.6% higher when no pharmacist was present to check medication orders in the ER. Following an in-depth review of topics and study designs that involved pharmacists, Ellitt (2009) recommended that pharmacists continue their successful interventions and multidisciplinary collaborations to ensure continuity of care and optimal pharmacotherapeutic outcomes. Given the importance of pharmacists to the healthcare system and to maintaining the health of the U.S. population, the availability of pharmacists in adequate numbers is a crucial issue. Healthcare providers and professional organizations report signs of a moderate current shortage of pharmacists, as indicated by persistent vacancy rates, difficulty recruiting and retaining pharmacists, growing dissatisfaction among pharmacists due to working long hours, and rising costs to employ pharmacists (DHHS, 2008). Whether or not there is indeed a shortage of pharmacists is beyond the scope of this inquiry. However, it is conceivable that environmental factors may play some role in the distribution of pharmacists that could result in either a shortage or surplus. From the perspective of the pharmacist supply, perceptions of key players may warrant some exploration within the context of the population ecology framework.

Eighty six percent of hospital CEOs surveyed by AMN Healthcare, the nation's largest provider of clinical staffing, believe there is a shortage of pharmacists (AMN, 2009). Forty six percent of the CEOs surveyed see this perceived pharmacist shortage as serious, while another 46% see the perceived shortage as moderate (AMN, 2009). To put these percentages in perspective, only 30% of these hospital CEOs thought they had enough pharmacists at their facility.

In light of perceptions that there is a shortage of pharmacists, it appears there is indeed a need to understand the environmental factors that influence the pharmacist supply in the U.S. In the next section, a summary of the Bureau of Health Professions model to evaluate the supply of pharmacists in the US will be presented and its utility in understanding the factors that influence the supply of pharmacists will be discussed.

Pharmacist Supply in the United States

The Bureau of Health Professions Model.

The Bureau of Health Professions (BHP) developed a model that is based on a year-by-year progression of cohorts of pharmacists (Gershon, Cultice, & Knapp, 2000). The pharmacist supply in any given year is the sum of the male and female pharmacists from 1-year age group cohorts starting at age 24 and extending to age 75. The data for each of the base cohorts were drawn from the 1989-1991 Pharmacist Manpower Project (PMP) (Gershon et al., 2000). The final calculation of pharmacists for each year is based upon varying scenarios using the latest available data on enrollment and graduate trends and assumptions about losses from the supply pool. This calculation is a projection of the number of new entrants into the pharmacy industry while subtracting both the number of base year pharmacists and new entrants who will die or retire (Gershon et al., 2000). International Pharmacy Graduates (IPGs) were also accounted for in BHP's pharmacist supply model. A table depicting the Pharmacist Supply Model is presented in Appendix A.

The growth rate of pharmacists during the 1980s and 1990s outpaced that of other healthcare professions, such as nurses and physicians (Shih, 1999). The ratio of pharmacists per 100,000 population from 1995 to 2020 is expected to increase from 68.9 pharmacists per 100,000 population to 76.7 per 100,000 (Gershon et al., 2000). There is a predicted growth rate of pharmacists of 13% between 1995 and 2020. Many observers have predicted that the pharmacist supply will outpace the growth rate of the United States population during the same period of time (Gershon et al., 2000).

Despite this appearance of growth in the pharmacist supply, there continues to be concerns about a shortage of pharmacists needed in the United States. Until 1998 the supply of pharmacists in the U.S. appeared to be in reasonable balance with demand. However, this delicate balance vanished gradually due to market forces, particularly related to the increased use of prescriptions dispensed (Cooksey, Walton, Stankewicz, & Knapp, 2003). In the pharmacy setting it is important to have the appropriate manpower to meet the needs of the population. The proportion of pharmacists working with three or more technicians increased from 33% to 46% between 2000 and 2004 (Mott, 2005). Mott's finding seems to point to a societal need for increased pharmacy manpower. One might infer that the need for more pharmacy technicians is closely tied to an increased volume of prescriptions that need to be filled. There may also be a perception for a need for more pharmacists to provide administrative support for the delivery of pharmaceutical care and general oversight for all aspects of pharmacy operations as an increasing number of pharmacists find themselves supervising more pharmacy technicians on their shifts.

The imbalance involving the demand for and supply of pharmacists is so severe in some instances that pharmacies must close on certain days or shutdown all together due to lack of pharmacists to staff their facilities (Buscher, 2005). Over the years, various observers have attempted to identify and describe the factors that affect the pharmacist supply. Among such attempts was the Aggregate Demand Index (ADI). In 2007, the National Association of Chain Drug Stores (NACDS) reported over 3900 pharmacist vacancies (NACDS, 2007). A summary of the NACDS surveys can be found in Appendices A, B & C. The development of the ADI represents one-step toward understanding societal needs and pharmacist workforce dynamics. The ADI was developed by the Pharmacy Manpower Project (PMP), whose purpose is to collect, analyze and disseminate data on the supply of and demand for licensed pharmacists and pharmacy services in the U.S. The PMP is an independent not-for-profit organization created in the late 1980s when the demand for pharmacists exceeded the national supply. The PMP is comprised of numerous organizations such as the Academy of Managed Care Pharmacy, American Association of Colleges of Pharmacy, American Pharmaceutical Association, American Society of Consultant Pharmacists, American Society of Health-System Pharmacists, and the Bureau of Health Professions (Knapp, 1999). The ADI is an ongoing, monthly survey by members of the PMP who are directly responsible for hiring pharmacists. The members of the PMP who are responsible for completing the questionnaire that generates the ADI do not receive compensation and serve by invitation based on their organization's direct role in hiring pharmacists (Knapp & Livesey, 2002).

The monthly survey is delineated by state and average demand index scores and is important to this study because the ADI addresses two broad areas of the pharmacy workforce. First, the ADI questionnaire contains questions that can be used to determine if there is a pharmacist shortage in a state. If there indeed is a shortage, the ADI allows observers to determine the degree to which the shortage affects the citizens of the state. The ADI also permits observers to determine if there is a national shortage of pharmacists and the degree to which a national shortage affects the citizens of the United States as a whole. The second area of the pharmacy workforce that the ADI addresses is pharmacy workforce shortage severity. The ADI allows observers to describe the effect of a shortage by looking at pharmacy practice settings (Knapp, Quist, Surrey, & Miller, 2005). There is a projected need for over 400,000 pharmacists by the year 2020 according to estimates presented during a PMP conference in the early 2000s (Knapp & Livesey, 2002).

It is imperative to understand not just fluctuations in the number of pharmacists, but the antecedents to the supply so that it is determined how to appropriately adjust health manpower resources to bring about a balance in demand and supply. The lack of pharmacists is not relegated to one region. It seems there are issues across the entire country from the east coast to the west coast (Vandervoet, 2007). Some of the factors considered are demographics of the population, health organization direction, and drug use trends.

No setting is immune to a deficiency in pharmacist manpower; even hospitals are also having difficulty meeting adequate pharmacist staffing levels (Wisconsin Hospital Association, 2006). Lack of pharmacists can lead to individuals not being able to fill their medications in their geographic vicinity, which can lead to patients having to travel to distant locations in order to have their prescriptions filled. The lack of pharmacists also leads to increasing salaries and sign-on bonuses to recruit pharmacists. In addition, geography can significantly affect the nature of a pharmacist's work. A pharmacist's applicable skill may be dependent, to a certain degree, on the availability of other health providers in or near that community (Manasse & Speedie, 2007). Communities have a strong desire to retain their pharmacists, because these individuals provide expert health advice and fill prescriptions, while serving, either formally or informally, as health educators, thereby improving the community's public health (Manasse & Speedie, 2007).

An adequate supply of pharmacists is important for the efficiency and effectiveness of the healthcare system. A shortage of pharmacists can affect other healthcare providers and the care patients receive (Ricuitti, 2001). A shortage in pharmacists is believed to stem from a rapid increase in demand and a limited ability to increase supply (Talley, 2001). An overworked labor force due to potential shortages creates the possibility for increased incidences of medication-related errors, adding more stress to the pharmacist's already busy day. This correlates strongly with the Institute of Medicine (IOM) report on medication errors.

The IOM pointed out that maintaining reasonable working hours, workloads and staffing ratios, and avoiding distractions, are needed in order to keep errors to a minimum (IOM, 2000).

Mott et al. (2002) considered work variables (e.g., work status, part-time work, secondary employment, and full-time equivalents) in their examination of characteristics of actively practicing pharmacists in the United States between 1990 and 2000. The findings of their study have some significance in the present context because the trends they identified are among the environmental factors that affect the pharmacist supply. Unlike previous studies, Mott examined time series data instead of questionnaires involving opinions and perceptions. Mott's approach is consistent with this inquiry because it begins to fill in gaps in the literature where the pharmacist supply is concerned. This inquiry is more explanatory in nature therefore much of the research on the pharmacist supply has been descriptive in nature. Such research documents the balance or imbalance between the pharmacist supply and demand but does not provide much insight regarding the interaction of the factors that contribute to the situation. Explanatory research is expected to generate empirical knowledge about factors that impact the pharmacist supply and provide insights as to how such factors are interrelated.

Data for the Mott et al (2002) study were obtained from two national studies of the pharmacist workforce conducted in 1990 and 2000. The study contained the final report of the 1990-1991 National Pharmacists' Compensation Survey by Schondelmeyer, Mason, Miller, and Kibbe (1992). The survey focused on personal profile, current employment profile, compensation profile, and fringe benefits in addition to other compensation of pharmacists and attempted to explain how these all contributed to the size of the pharmacist workforce. The second survey was the National Pharmacist Workforce Survey conducted by Pedersen, Doucette, Gaither, Mott, and Schommer (2000). Insofar as the demand for pharmacists is concerned, results from these studies suggest that the current pharmacist workforce has responded to an increased demand for pharmacists by increasing the amount of work supplied to the pharmacist labor market, while limiting the number of pharmacists working outside the profession. The net effect of such trends appears to be fewer pharmacists performing more tasks.

Factors Affecting the Supply of Pharmacists

Pharmacist Education and Training.

One factor affecting the supply of pharmacists is the extent of the training process. There has been a lengthening of the training period for United States pharmacy students. In the past, pharmacists were only required to obtain a Bachelor of Science degree in order to be eligible to take the National Pharmacist Licensing Examination (NAPLEX). In 2003 the American Council on Pharmaceutical Education (ACPE), which is responsible for the accreditation of professional degree programs in pharmacy and providers of continuing pharmacy education, changed the minimum requirement to practice pharmacy to persons who received the Pharm.D. as the entry level degree from an ACPE accredited school of pharmacy. The new requirements also restricted eligibility for accreditation to those schools offering the Pharm.D. as the entry level degree (DHHS, 2000).

This change compelled schools with B.S. programs to develop curricula to meet the new ACPE program standards. As a result of the new curriculum requirements, the scope of pharmacy practice has been significantly broadened and has set the stage for inquiries such as this one to explore factors affecting the pharmacist supply. A study conducted by Baran, Shaw, and Crumlich (1998) found that Pharm.D. students were attracted to hospital pharmacy settings, whereas more students in the B.S. program saw their future practice setting in a community pharmacy. If this is true, there is the potential for a shortage of pharmacists in the community setting, assuming that there are enough hospital positions to accommodate holders of the

Pharm.D. degree seeking such positions. This has very important implications for the pharmacist supply, at least insofar as site and scope of practice may be concerned.

Approximately 20% of pharmacy graduates seek additional postgraduate education in a variety of fields (e.g., residencies and fellowships, master of business administration, doctor of law, master of public health, doctor of philosophy) (Manasse & Speedie, 2007). A majority of pharmacy school graduates seek one-year residency training positions in an attempt to increase their opportunity for a position involving direct patient care.

While a residency is not required to practice pharmacy, some healthcare institutions make this a requirement for employment; especially when it relates to certain clinical specialties (American Society of Health-System Pharmacist, [ASHP], 2007; Kostick, 2006). Those desiring academic or research roles in academia or the pharmaceutical industry often complete two to three years of fellowship training in addition to a one- or two-year residency.

To compensate for the increased length of time to add pharmacists to the workforce, some schools have increased their class size. Another measure taken by the profession is to open new pharmacy schools. The increase in pharmacy schools that began in the 1990s and continue currently accounts for a 35% increase in the pharmacist supply (Knapp & Cultice, 2007). Between 2001 and 2009 alone 31 new pharmacy schools were established (American Association of Colleges of Pharmacy, 2010). The rate of new schools may be an important environmental factor affecting the pharmacist supply and should be accounted for in research on the pharmacist supply in the U.S.

Age and Retirement.

It is also noteworthy that the median age of the pharmacy workforce is increasing. Mott et al. (2005) reported that 44% of the practicing pharmacists surveyed in 2000 were 40 years of age or younger compared to 33% in 2004.While the percentage of younger pharmacists decreased during this period, the percentage of practicing pharmacists over the age of 55 increased from 17% to 25% (Mott et al., 2005). This indicates that the supply of pharmacists may decrease as the older pharmacists take retirement and there may not be enough younger, trained pharmacists to take their place. If there is not a shortage, per se, age trends among licensed pharmacists could portend a misdistribution of pharmacists. Both of these situations may significantly affect the supply of pharmacists.

Patient Interaction.

Pharmacists are crucial in medication reconciliation and consultation with physicians and patients. Pharmacists are vital to ensuring that quality pharmacy services are provided, while transforming the practice of pharmacy to increase patient education on the proper use of pharmaceuticals (Kong, 1995). In some instances a community pharmacy may be utilized as a healthcare facility and may provide more services than what may be typically expected of or available in a traditional community pharmacy. This is most likely to be the case in areas where medical offices and clinics are in short supply. According to Knapp, Paavola, Maine, Sorofman, and Politzer (1999), pharmacies may be a place where patients receive medical consultation and education by pharmacists and other health professionals.

Pharmacist Practice Setting and Salary Forecasting.

As prescription volumes continue to increase so does the level of salaries being offered to pharmacists by employers. A Drug Topics' 2010 salary survey drew 1,619 responses from across the country, with respondents earning an average salary of $115,455 (Rajecki, 2010). A previous survey by Drug Topics found that pharmacists working in health maintenance organizations received the highest annual salary at $114,067; followed by pharmacists who practice at independent pharmacies ($109,618); mass-merchandisers ($109,466); chains ($107,885); hospitals ($107,168); supermarkets ($106,302); and mail order ($101,500) (Levy, 2008).

While pharmacist salaries continue to increase there are signs that increases are slowing. One example is the amount of extra income pharmacists took home between 2002 and 2006. Only 50% of the respondents received additional pay from sources such as bonuses and profit-sharing, compared with 88% in the 2000 survey (Ukens, 2007).

Annual raises are also continuing to trend downwards for pharmacists. Ukens reported an average raise of 3.8% in 2006, compared with 4.9% in 2004 and 7% in 2002. Rising salaries for pharmacists have a positive impact on supply, however it has also led to pharmacies scaling back on the number of hours they are open and scaling back on staff due to rising labor costs (DHHS, 2008).

Increase in the number of Women in Pharmacy.

One trend that is occurring quite rapidly is the number of females entering the profession. Presently more females are applying to pharmacy school and receiving degrees than males. In 2006, 59.5% of applications to schools and colleges of pharmacy were submitted by women; they also received 68.2% of the first professional pharmacy degrees conferred in that year and 60.8% of the post baccalaureate degrees conferred (Deyton et al., 2007). The percentage of licensed female pharmacists increased significantly from 31% in 1990 to 43% and 46% in 2000 and 2004, respectively (Mott, Doucette, Gaither, Pedersen, & Schommer, 2002). This information is presented in Figure 1.

According to Mott et al. (2005) approximately 30% of female pharmacists surveyed between the ages of 31 and 60 worked part-time. Approximately 3% of male pharmacists

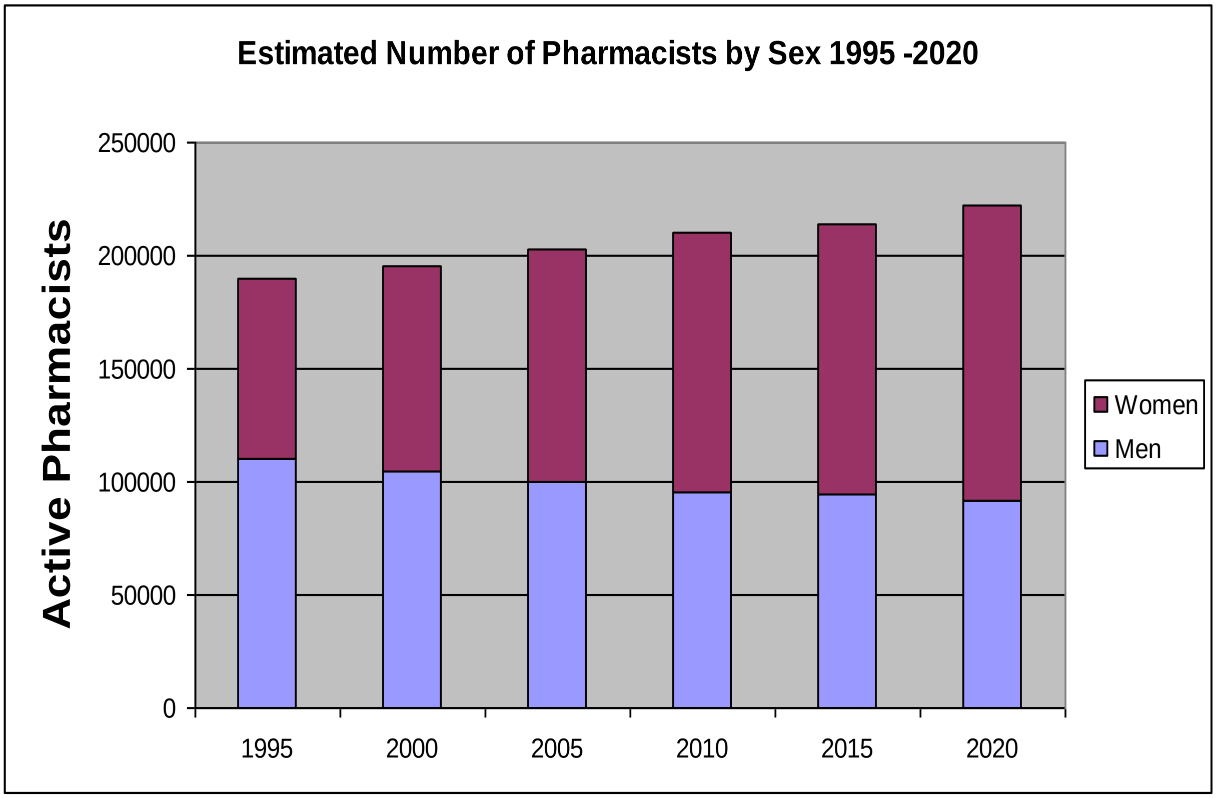


Figure 1. Estimated Number of Pharmacists by Sex, 1995-2020**.**
From "How Many Pharmacists Are in Our Future? The Bureau of Health Professions Projects Supply to 2020," by Gershon et al., 2000, *Journal of the American Pharmacists Association*, *40*(6), p. 760.

between 23-40 years of age work part time compared to 23% of their female counterparts (Mott et al., 2002). There may be many factors affecting this difference in the percentage of female and male pharmacists working part-time. This difference is noteworthy because of its implications for pharmacy manpower. Women are more likely to work part-time during the childbearing years. This can further affect the pharmacist manpower needs of the environment.

The number of pharmacists may indeed be increasing. However, due to trends such as the one described above there could still be a shortfall in the number of pharmacists available to fill prescriptions due to more females working part-time.

Summary of Environmental and Demographic Factors Affecting Pharmacist supply in the Literature

There appears to be a consensus in the literature that a myriad of factors and interactions among these factors affect the supply of pharmacists in the U.S. Among the factors that previous studies have examined in relation to the number of pharmacists are rates of pharmacist employment turnover, antecedents to pharmacist workforce decisions (e.g., reasons pharmacists give for choosing part-time employment over full-time employment), pharmacist-to-population ratio, rate of opening of new schools of pharmacy, age, practice venue (e.g., hospital or institutional versus community), prescription volume and salary. Many observers believe that even with growth in the number of pharmacists, strong factors of demand may confound the adequacy of the supply of pharmacists. The net effects of supply trends may lead to a shortage or misdistribution of pharmacists. Whether there is a shortage or surplus warrants a separate inquiry that explores this phenomenon specifically. The focus of this inquiry is the impact of environmental factors on the overall pharmacist supply.

The rapid growth in prescription volume, the increase in new drugs and its greater complexities and the growth in the elderly population are additional factors that may have a significant and remarkable impact on the supply of pharmacists (Gershon, Cultice, & Knapp, 2000).

Factors Affecting the Demand for Pharmacists

Physicians are primarily responsible for the volume of prescriptions written, so the locations of their practices and the volume of prescriptions written play a crucial role in the pharmacist supply. The number of prescriptions dispensed per year in the United States has increased from approximately 1.9 billion to 2.9 billion between 1992 and 2004 (Stagnitti, 2007).

The increase in the insured population is significant because it leads to a potential increased workload for pharmacists striving to meet the prescription demand. The continuous development of new drugs, many of which have high costs, will stimulate demand for more pharmacists now and in the future. It is important to also note that managing drug interactions is becoming more complex as a result of numerous drugs being used to treat multiple chronic conditions. This problem is especially worrisome in hospital settings. Taken together these facts certainly suggest that there will be an increased demand for pharmacists. Their expertise will be sought by physicians and patients alike in all healthcare settings.

Physicians will be providing care to larger numbers of elderly persons in their practices in the coming years. These patients often require multiple medications to manage their health problems. Consequently, physicians write more prescriptions and patients are at greater risk for drug interactions and medication misadventures. Under such circumstances it would appear reasonable to expect that there will be a greater demand for pharmacists. Insofar as the elderly and prescription volume are concerned, the passage of Medicare Part D is expected to have a very remarkable. In addition to Medicare Part D is the passage of the 2010 Healthcare Reform Act, both of which may have a positive impact on the demand for pharmacists.

Physicians and the Increased Volume of Prescriptions.

In light of their role as the primary source of prescriptions being written, any examination of factors affecting the pharmacist supply should include some consideration of the physician supply; as the forgoing discussion suggests. It is reasonable to assume that the likelihood of a patient receiving a prescription as a result of a visit to their physician may increase as new medications become available to treat more conditions.

Access to prescription drugs is facilitated by an increased number of prescribers, primarily physicians. The number of primary prescribers ((Medical Doctors (MDs) or Doctors of Osteopathy (DOs)) per 1,000 population has increased steadily since 1985 (Kaiser Family Foundation, 2000). The percentage of office visits with multiple drug orders increased from 45.3% in 1985 to 58.1% in 1999 (Burt, 2002).

In this study it was also shown that once the distribution of visits by patients' age, number of diagnoses, source of payment, and physician specialty are adjusted for, physicians were 43% more likely to prescribe multiple drugs in 1999 than in 1985. The development of better treatments involving pharmaceutical interventions will also lead to a greater dependence on such drugs for maintaining a high quality of life (Burt, 2002). According to Mott et al. (2005) 61% of pharmacists working in chain settings (e.g., CVS, RiteAid, Eckerd) reported dispensing over 200 prescriptions per day. Findings in the literature clearly suggest a direct, positive correlation between prescription volume and the demand for pharmacists. As prescription volume increases, so does the demand for pharmacists.

According to the National Ambulatory Medical Care Survey (NAMCS), in 1996 there was an estimated 734.5 million visits made to physician offices in the United States (Woodwell, 1997). There were over 210 million more physician office visits in 2005 than in 1996 (Cherry, Woodwell, & Rechtsteiner, 2007). Nearly two-thirds of the visits made to ambulatory physicians' offices in 1996 resulted in at least one medication being provided by or prescribed by the physician; or about 469 million prescriptions (Woodwell, 1997). There were over 120 million physician visits in 1996 made by patients who had at least three medications provided by or prescribed by a physician. This number has more than doubled by 2005 (Cherry et al., 2007).

According to the Agency for Healthcare Research and Quality (AHRQ) Medical Expenditure Panel Survey (MEPS), physicians wrote over 4 billion prescriptions in 2007 with physicians being primarily responsible for the majority of the prescriptions written (Medical Expenditure Panel Survey, 2008). Presently there are more than 750,000 physicians practicing in the United States, with a physician supply projection of more than 900,000 by the year 2020 (DHHS, 2006).

Prescriptions filled by chain drugstores alone increased by 7% between 2005 and 2007, from 3.3 billion in 2005 to 3.52 billion in 2007 (NACDS, 2008). These figures suggest there will be an increasing need for more pharmacists to dispense the rising number of prescriptions being prescribed by physicians.

Employers and Pharmacist Workload.

The primary source of prescription drug coverage for most Americans (both non-Medicare and Medicare) is their employers. For retirees and the majority of persons age 65 and over Medicare Part D is the primary source of coverage for prescription drugs. In 2008, 157 million Americans (60% of the nonelderly population) were covered by employer-based health insurance (Kaiser Family Foundation, 2009). Approximately 99% of employees under employer health plans have drug coverage (Kreling, Mott, Wiederholt, Lundy, & Levitt, 2000; Kaiser Family Foundation, 2007).

Another important demographic factor potentially impacting the demand for pharmacists is the size of the business industry. The more employees there are in an organization or industry the greater the demand will be for benefits and services (Sommers, 2004). Among the 80.1 million employees who worked for large private sector employers in 2002, 97.8% were offered employer-based health insurance and 62.7% of those employees enrolled in plans offered by their employers (Sommers, 2004). Organizations with large numbers of employees are more likely to offer their employees health insurance (Stanton, 2004).

These facts are particularly salient in the context of this inquiry because employer sponsored insurance enrollees are 4 times less likely to forego filling a prescription drug due to cost as compared to the uninsured population, according to findings reported by Cunningham (2002) from the community tracking study household survey. As a result, it would be expected that the demand for pharmacists to be greater in such communities due to a larger volume of prescriptions to be filled. In 2006 the health plan offer rate for large or medium organizations (50 or more employees) was 96.7% compared to 61.2% for small organizations (50 or less employees) (Sommers & Crimmel, 2008; Crimmel & Sommers, 2008). Reed & Hargraves (2003) reported that the uninsured population was more than three times as likely as those with private health coverage to have gone without at least one prescription in 2001 because of cost concerns. Poisal and Chulis (2000) reported that Medicare beneficiaries with some type of prescription drug coverage utilized an average of five more prescriptions per person than beneficiaries that were uninsured.

It is plausible that if the proportion of persons covered by employer-sponsored plans increases substantially in a region, there could be a disproportionately greater need for pharmacists as a result of more persons then being covered by such plans. An analysis of such trends might lead one at first glance to conclude that there is a sharp and sudden increase in health conditions requiring prescription medications. However, it is more likely the case that the increase may be due to more persons having their previously unmet prescription drug needs met as a result of health insurance coverage that includes coverage for prescription drugs. In any event there will presumably be a need for more pharmacists to handle the increase in prescription volume and to provide expert recommendations to manage all aspects of pharmacotherapeutic interventions to ensure safety and efficiency.

Health Insurance and Paying for Prescriptions.

Americans obtain health insurance to help cover their expenditures related to the receipt of healthcare. One aspect of receiving healthcare is the acquisition of prescription drugs and pharmacotherapy services. In general, Americans purchase health insurance either individually, paying out of their own pocket or through their employers as a benefit of employment.

In the latter instance the employer may provide coverage for their employees by fully assuming the financial burden of providing it, or through some degree of cost sharing involving employers and employees.

According to the United States Census Bureau (2006), in 2005 approximately 84% of the United States population was insured through the government or private companies. The majority of health plans provide coverage for prescription drugs, to varying degrees. According to findings reported from the Health System Change (HSC) survey, approximately 12-13% of American adults had problems filling a prescription between 2001 and 2003 (Reed, 2005).

Insurance coverage has the potential to have a positive impact on the demand for Pharmacist's because of its positive effect on the ability to obtain required prescriptions (Ranji, Wyn, Salganicoff, & Yu, 2007; Weinick, Byron, & Bierman, 2005). The ability to pay for prescriptions plays a vital role in the volume of prescriptions to be filled, which in turn plays a role in the need for pharmacists. In order to employ and retain pharmacists there must be a constant flow of patients in need of prescription medicines. Health insurance is usually the primary source for paying for prescriptions. The growth of drug insurance coverage has improved access to prescription drugs and the services of pharmacists. Ultimately, the growth of insurance for prescription medications is very likely to precipitate a greater demand for pharmacists and the services that they provide (Knapp, 2002). Findings in the literature suggest that having insurance is associated with a higher volume of prescriptions.

The implementation of Medicare Part D is one example of the effect of insurance for prescription medications on the demand for pharmacists. It has been estimated that Medicare Part D will allow 15 million elderly Americans with no prescription drug coverage to now obtain coverage for prescription drugs. In turn, observers have projected that an additional 14 to 30 million prescriptions will be written and dispensed each month following the implementation of Medicare Part D (Reissman, 2004).

While it is clear that being insured greatly affects one's ability to obtain healthcare, including prescription drugs, it is also clear that the lack of insurance nearly always leads to a corresponding inability to obtain healthcare and prescription drugs. From a practical point of view, it would seem reasonable that the percentage of the population that is uninsured may have an impact on the pharmacist supply. In this case there may be a decreased demand for pharmacists as the volume of prescriptions may be lower.

Reed and Hargraves (2003) reported that in 2001 the uninsured were more than three times as likely as those with private health insurance to forgo at least one prescription because of cost concerns. In a study involving data from the HSC Reed (2005) reported that, regardless of insurance coverage, low-income adults (incomes 200% below the federal poverty level, or $36,800 for a family of four in 2003) faced significant financial barriers to obtaining prescribed drugs. As mentioned above, the percentage of uninsured persons in the population at a given point in time is one environmental factor that could significantly reduce the demand for pharmacists and, thus, affect the pharmacist supply.

On March 23, 2010, President Barack Obama signed into law the Affordable Care Act. The law puts into place comprehensive health insurance reforms that will help in lowering healthcare costs, while guaranteeing more healthcare choices, and enhanced quality of healthcare for all Americans (DHHS, 2010). The main selling point for the healthcare reform package put forth by the Obama administration is that it offered healthcare benefits to some 32 million uninsured Americans (Wechsler, 2010). Another major, positive step put forth by that legislation was its promise to address the coverage gap or "donut hole" which affects one in four Medicare Part D beneficiaries (Steffancci, 2010). The coverage gap, which occurs in the majority of Medicare Part D prescription drug plans, involves beneficiaries paying the entire cost of their prescription drugs, once they reach a certain limit. This limit is reached once a senior has spent $2830 on prescription drugs in 2010. This limit lasts until catastrophic coverage kicks in (when a Medicare beneficiary has spent $4550 out-of-pocket on medications) (Steffancci, 2010).

The Obama administration's healthcare reform bill has developed a plan to start gradually closing the donut hole with an anticipated full closure by 2020. As of 2011, pharmaceutical manufacturers required to provide a 50% discount on brand-name prescriptions in the Medicare Part D coverage gap. In 2013 federal subsidies for generic prescriptions will be phased in while the out-of-pocket amount that qualifies an enrollee for catastrophic coverage under Medicare Part D will gradually be reduced beginning in 2014 and continuing through 2019 until the donut hole is completely closed (Wechsler, 2010).

These changes to Medicare will augment drug usage by seniors. From changes in health insurance parameters to quality assurance modifications, this legislation will alter the health-care environment for providers in the US. Prescription drug coverage is included on the list of essential benefits required to be offered by all insurance plans pursuant to mandates in this historic legislation. Decreasing copayments and other expenses associated with prescription medication use will expand pharmaceutical benefits to patients in need, and conceivably, lead to a greater need for pharmacists.

The healthcare reform initiated in 2010 has the potential to provide tens of millions of Americans with access to healthcare coverage and allow others to retain coverage. The researcher further notes that the laws that constitute healthcare reform seem to have a potential two-fold impact on the pharmacist supply. First, there is a new requirement that premium subsidies be provided for individuals to purchase health insurance. As previously discussed, as access to insurance increases the volume of prescriptions written and subsequently dispensed also increases, directly increasing the demand for pharmacists and the services they provide. Secondly, new laws that have been enacted as a part of healthcare reform require that tax credits be given to small employers as an inducement for them to offer health insurance to their employees (Matzke, 2010). Matzke further notes that a swell in the number of insured individuals are expected to significantly increase prescription drug use and lead to an expanded role for pharmacists in the U.S. healthcare system through medication therapy management (MTM) programs (Matzke, 2010). It is difficult to accurately project exactly how the pharmacist supply will be impacted by the healthcare reform begun in 2010. The purpose here is to just give insight into future changes in the environment that may affect the pharmacist supply in the future.

Increasing Complexity of Medications and Pharmaceutical Treatment.

The increase in the number of medications developed to treat varying medical conditions has increased the need for pharmacists to help manage drug utilization. Additionally, there has been the introduction of pharmaceuticals to treat diseases for which drug therapy previously was not available or had limited efficacy (Mott & Kreling, 1994).

The increasing acuity of hospitalized patients receiving complex medication regimens, in conjunction with the national focus on medication safety, and the increasing number of drug safety warnings issued by the Food and Drug Administration that focus on medications, strongly support the need to identify and describe factors affecting the pharmacist supply (Shane& Gouveia, 2009). Pharmacists are an integral part of the healthcare team in the hospital and other healthcare settings and they are very involved in the management of a variety of illnesses, especially those requiring complex drug therapies such as chemotherapy or treatment for life-threatening infections.

Pharmacists are best poised to oversee the entire drug distribution system including prescribing, dispensing, and administration and safety of drugs. Such oversight by pharmacists clearly describes the important role they play in improving medication safety (Guchelaar, Colen, Kalmeijer, Hudson, & Teepe-Twiss, 2005). Geography can significantly affect the nature of a pharmacist's work. A pharmacists' applicable skill may be dependent, to a certain degree, on the availability of other health providers in or near that community (Manasse & Speedie, 2007). Communities have a strong desire to retain their pharmacists because they provide expert health advice, fill prescriptions and serve as formal or informal health educators (Manasse & Speedie, 2007).

Growth in the Older Population and Those with Chronic Diseases.

The graying of America also seems to be having an impact on the number of prescriptions written. As Americans live longer, and as the population of persons 65 years of age and over increases, the volume of prescriptions being filled per year continues to grow. There is expected to be an increase in the number of prescriptions written by physicians treating the elderly as the baby boom population enters late life. This is because the over 65 segment of the population consumes a disproportionately higher volume of prescription medicines than the rest of the population (ASHP, 2001).

Older patients generally have more chronic illness than younger individuals, which usually leads to more complicated medication treatment plans. Eighty-five percent of Americans 65 years of age and older have at least one chronic disease that is primarily managed with a prescription drug (ASHP, 2001). This trend suggests that there will be an increase in the volume of prescriptions to be filled and dispensed. Concomitant with any increase in prescription volume will be the need for more pharmacists (Deyton et al., 2007).

To put the volume of prescriptions in perspective, there were approximately 1.9 billion patient prescriptions filled in 1997, versus 2.9 billion in 2004 (Stagnitti, 2007). During the period 1997 to 2004 there was a 40% increase in the average number of prescriptions filled per person per year for persons over the age of 65. In 1997 persons over the age of 65 averaged 21.9 prescriptions per year compared to 30.8 prescriptions per year in 2004 (Stagnitti, 2007). These figures are more than twice those for persons under 65 years of age, who averaged 8.8 and 12.6 prescriptions per year, respectively, during the same period of time.

It is estimated that 77 % of the over 65 population surveyed regularly use three or more prescription medications (ASHP, 2001). The over 65 population comprises approximately 13% of the total U.S. population, or just over 40 million people (U.S. Census Bureau, 2008). This segment of the population is projected to grow significantly over the next few decades, especially the 85 and over segment of those over 65 years of age. Current projections estimate that the over 65 population will account for 18% of the U.S. population in 2020 and 22% in 2030 (U.S. Census Bureau, 2008).

The Medicare Prescription Drug Improvement and Modernization Act (MMA) were signed into law in 2003 and went into effect on January 1, 2006 (Gore & Seeds, 2004). The MMA's goal was to provide an estimated 7 to 15 million older Americans who had no prescription drug coverage with such coverage with the addition of Medicare Part D. Medicare Part D is aimed primarily at helping these individuals by providing them with assistance in paying for the prescription drugs they need. As a result of the MMA, all Medicare beneficiaries are able to enroll in a prescription drug plan. It is estimated that as many as 14 to 30 million additional prescriptions may be written and dispensed each month by retail pharmacies as a result of MMA (Reissman, 2004). Increased pharmacist manpower will likely be needed to address the increasing elderly population and its large and varying consumption of medications.

Central Fill Pharmacies.

The decade following 2008 was marked by an emerging trend within the pharmacy profession that could conceivably impact the future of the profession in coming decades. The time period for this inquiry covers the 16 years between 1994 and 2009. This emerging trend is believed to have occurred toward the end of this time period and will not be examined in this inquiry. However, the trend warrants being mentioned here because of its theoretical importance in examining environmental factors affecting the pharmacist supply.

At the core of this trend is the increasing use of central fill operations to accommodate increased demand for pharmacist services caused by an increasing volume of prescriptions to be filled. Key players in the profession appear to be developing these central-fill pharmacies to act as mass-dispensing centers for retail pharmacies to meet the growing demand for pharmacist services at the retail level.

These centers are allowed to receive non-controlled and controlled substance prescriptions from retail pharmacies as long as they subsequently dispense the prepared prescription to the same originating retail pharmacy (Anderson & Crawford, 2010). Central-fill pharmacies are not allowed to take prescriptions directly from a patient or practitioner and they are not allowed to dispense prescriptions directly to a patient or practitioner.

While a closer examination of this emerging trend is beyond the scope of this inquiry, it would be remiss to not mention it because it may be a noteworthy environmental factor affecting the supply of pharmacists in the future. One major benefit of central-fill pharmacies is that they enable busy retail pharmacies to send their entire volume of prescriptions (especially refills) to a central location for processing. In terms of our theoretical framework, these central fill pharmacies are likely to have an appreciable effect on two of the constructs in the population ecology framework: density and concentration. Central fill pharmacies may very well alter the distribution of pharmacists and, thereby, significantly impact pharmacist supply.

Having the option of sending prescriptions to another location to be filled frees staff in local retail pharmacies to concentrate on dispensing acute care prescriptions and to perform other essential duties such as patient counseling and medication therapy management (MTM) (Chain Drug Review, 2010). Future studies of the pharmacist supply using the population ecology theoretical framework should include an examination of this trend toward central fill pharmacies to shed more empirical light on its impact.

Studies on the Pharmacist Supply

This section summarizes studies that have examined environmental factors impacting the pharmacist supply in the United States. Practice setting can affect the extent to which pharmacists can serve as active members of collaborative healthcare teams in the community (Schommer, Reshmi, Cline, & Hadsall, 2006). It seems very likely that the pharmacist supply may be significantly affected by the realization of these goals by future pharmacists.

Walton et al. (2004) examined supply and demand factors across states and analyzed differences in relation to pharmacy labor using data from the Bureau of Labor Statistics (BLS). BLS estimates of the number of filled pharmacist positions were used to generate state-level data regarding the size of the pharmacist labor market. BLS estimates rely on industry surveys that require the selected industry to disclose the number of filled positions they have for each occupation on the list.

Based on their analysis of BLS data, Walton et al. (2004) stated that the pharmacist supply can be explained in terms of four variables: 1) wages earned by pharmacists in a state; 2) the number of new graduates; 3) the number of existing pharmacists; and 4) work preferences. Demand was defined as the number of pharmacist positions available at a given wage in each state.

These investigators also determined that the demand for pharmacists at the market level is positively related to the number of community pharmacy prescriptions and population. They reported that after controlling for population, the number of filled pharmacy positions was significantly correlated with prescriptions, hospital days, pharmacies, and residents older than 65 years. Although not addressed in the Walton et al. (2004) study, Cherry et al. (2007) reported that demand can be affected by the supply of physicians in a state.

In another study, Walton, Knapp, Miller, and Schumock (2007) examined the relationship between demographic and economic variables in their attempt to understand variations in the pharmacist supply in America. Walton and his colleagues found that surrounding population size, community income levels, and the number of healthcare facilities all play a role in the future size of the pharmacist workforce.

Summary of Extant Studies on the Number of Pharmacists

There have been numerous studies on the factors that impact the pharmacist supply in America. Some of the key variables that have been common to a majority of the studies on the number of pharmacists in the literature are patient population, practice setting, practice location, salary, utilization of skills, benefits, pharmacy student enrollment, managed care penetration and insurance coverage, work hours, practitioner gender, prescription volume, demand for clinical pharmacy services, number of pharmacies in a community, number of physician visits, size of population over 65 years of age, per 100,000 population income, number of pharmacist vacancies in a community, number of physicians, size and number of employers, implementation of healthcare reform and passage of new laws.

In broad terms, these factors fall into one of three domains that have emerged from previous research on the pharmacist supply: (1) Demographic, (2) Ecological and (3) Institutional/Legal. A summary of studies in these domains is presented in Table 1 below. Findings from extant studies on pharmacist supply in the literature, when taken as a group, provides some insight into the interrelationships among factors that may determine the pharmacist supply in America (Knapp, 1999; Manasse & Speedie, 2007; Burt 2002; Meissner et al., 2006; & Sommers, 2004). The changing demographics of the pharmacy profession may require innovative approaches to recruitment, retention, and training of faculty and clinical specialists to meet current and future needs of a population that includes a growing number of persons with chronic illnesses and increasingly more complex pharmacotherapeutic regimens (Patry & Eiland, 2007).

While healthcare facilities try to find a way to meet their demands, retail pharmacies also must turn to the same pool of pharmacists to meet their demand as well. These facts point to the dire need for more empirical evidence about the factors that impact the pharmacist supply. Managing the balance between the demand for pharmacists and the supply of pharmacists will continue to be of paramount concern to the profession over the next several decades. In light of limited, dwindling resources, there must be ways found to maximize our resources to avoid critical imbalances between supply and demand for pharmacists. Several researchers have suggested a shortage of pharmacists.

Assessing the environment is a critical prerequisite for adequate workforce planning to address the challenges in maintaining a suitable number of pharmacists. Among the variables to be considered are increasing work-force demands, patient safety, resource constraints, and health work-force policy reforms (Wuliji, 2009). Understanding the environmental dynamics that help determine pharmacists supply and distribution throughout the United States may help communities, hospital administrators, and other pertinent personnel in determining the appropriate number of pharmacists to meet population demands. In this chapter the role and importance of pharmacists in the U.S. healthcare system have been reviewed. There was an exploration of factors that affect supply and demand and there was a discussion of the dynamic nature of the relationship between the two. Changes in the organization of healthcare services, including pharmacy services, changes in the demographics of the population and changes in the financing of healthcare will impact supply and demand where pharmacists are concerned. Table 1 provides a summary of studies that have been conducted on pharmacist supply/manpower.

Table 1. Summary of Research Domains on the pharmacist supply found in the Literature.

Key Variables	**Point of Interest**	**Reference**
Salary, utilization of skills, and benefits	Assessing the factors that impact pharmacy graduates' practice location preference	Besier & Jang, 1992
Student Program Enrollment Status, Pharmacy Practice Setting	Practice Location Preferences for B.S. and PhamD. Students	Baran & Cumlich, 1998
Pharmacists Manpower, Managed Care Penetration	The impact of managed care on pharmacy practices and the ability to retain roles that are useful to the system and satisfying to pharmacists in a changing healthcare system. Pharmacists participation in population-based patient management programs, adaptation to new relationships with other providers.	Knapp, 1999
Pharmacist population size, Pharmacy School Enrollment	Investigation of the existence of a pharmacist shortage in the United States for the years 1987 to 1991. Utilization of earnings data for pharmacists at a regional and state level to determine which areas of the U.S. or which individual states are most in need of more pharmacists by practice settings to determine supply levels.	Mott & Kreling 1994
Aging Pharmacist Population, Increased Hours worked and Increased female pharmacist population	The U.S. Department of Health and Human Services, Health Resources and Services Administration's (HRSA's) 2008 report on the pharmacist workforce documented the current and growing shortfall of pharmacists.	Department of Health and Human Services, 2000 & 2008
Pharmacist gender makeup, Pharmacist supply, Patient Population Data	To describe a Bureau of Health Professions model for estimating active pharmacists in the United States and its findings	Gershon, Cultice, & Knapp, 2000

Table 1. Summary of Research Domains on the Pharmacist Supply Found in the Literature (Continued)

Key Variables	**Point of Interest**	**Reference**
Demand for prescriptions or clinical services, patient population.	To estimate the impact that the new Medicare drug benefit program will have on pharmacy workforce demand.	Meissner, Harrison, Carter, & Borrego, 2006
Number of community/outpatient prescriptions dispensed Number of active community and outpatient pharmacy licenses, Number of active pharmacy licenses, hospital setting , Per capita income , Age > 65 years Number of filled pharmacist positions in the state , Number of pharmacy technician and pharmacy aide positions, Pharmacist wages	Examine the impact of supply and demand factors on filled positions for pharmacists and pharmacist extenders (pharmacist technicians and aides) and assess differences across states through analysis of state-level pharmacist labor market data	Walton, Cooksey, Knapp, Quist,& Miller, 2004
Prescription Growth, Growth of Pharmacies, Pharmacy Vacancies	Manpower issues for all pharmacy managers and the demand of prescription volume	Knapp, 2001
Number of Drugs Prescribed and Office Visits, Patient Population	A report that describes ambulatory care visits made to physician offices in the U.S.	Cherry, Woodwell, & Rechtsteiner, 2007
Institutional/Legal component		
Key Variables	**Point of Interest**	**Reference**
Trends of Hospital and Healthcare System pharmacy's, Recruiting and Retaining Staff	Assessment of Pharmacy's changing demographic	Deyton et al., 2007
Pharmacy Practice Expansion, Improvements in Medicare and Medicaid	Impact of Healthcare Reform on Pharmacy Practices	Matzke & Ross, 2010
Work status, part-time work, secondary employment, full-time equivalents	Examination of trends in work practices of pharmacists from 1990 to 2000.	Mott et al., 2002
Legislation, medication utilization, and mortality	Pharmacists, Pharmaceuticals, and Policy Issues that are Shaping the Work Force in Pharmacy	Manasse & Speedie, 2007

Understanding the environmental dynamics that help determine pharmacists supply and distribution throughout the United States may help communities, hospital administrators, and other pertinent personnel in determining the appropriate number of pharmacists to meet population demands.

In this chapter the role and importance of pharmacists in the U.S. healthcare system have been reviewed. There was an exploration of factors that affect supply and demand and there was a discussion of the dynamic nature of the relationship between the two. Changes in the organization of healthcare services, including pharmacy services, changes in the demographics of the population and changes in the financing of healthcare will impact supply and demand where pharmacists are concerned.

Previous research in this area has presented a nascent understanding of the confluence of myriad factors that may significantly impact the pharmacist supply, but there are gaps in our understanding of the context in which these factors operate and the interactions among them. An understanding of these factors will be useful to closing the gap that currently exists in our knowledge of the pharmacist supply and the interaction among the factors affecting it. Within the context of this inquiry, an understanding of the pharmacist supply and the factors affecting it can only come about as a result of an empirically based, purposeful examination using a rigid theoretical framework. It was proposed that the population ecology framework is suitable for the task at hand. There will be more in depth discussion of the population ecology framework in the next chapter.

Chapter 3: Theoretical Framework

The population ecology theoretical framework will be used to guide this inquiry of factors affecting the pharmacist supply in the United States. The population ecology theory is an adaptation of Darwin's theory of evolution and climactic change and consists of four main constructs: population, natural selection, niche and carrying capacity. In this chapter a there will be a description of the population ecology theoretical framework and statement of the hypotheses that will be tested in this inquiry.

The Impact of Darwin's Theory of Evolution on the Development of Population Ecology

Darwin's theory of evolution looks at growth and decline among species and accounts for growth and decline by considering the impact of environmental factors. The species that can adapt to an environment continue to thrive, and those unable to do so disappear over time. To illustrate the central premise of his theory Darwin thought that it might be helpful to consider a country undergoing some physical change, for instance, of climate.

A portion of the country's inhabitants would adapt to change and survive. The inhabitants that do not are likely to become extinct (Darwin, 1859). Darwin also noted that a numerical proportion of some of the inhabitants, independently of the climate change itself, would seriously affect the survival of many others. Darwin's theory of evolution by natural selection was based on the premise that species change and adapt to their environment with the fittest surviving and giving way to new species.

Darwin's observations have been the focus of studies in biology and various other scientific disciplines (Adami, Ofria, & Collier, 2000; Gavrilets & Losos, 2009; Schluter, 2009). Darwin's thoughts regarding variation in a population are focused on understanding the process of evolution (Bowler, 2009). He believed that variation in a population was not the result of some predetermined developmental trend. On the contrary, population variation was caused by something other than random variation. It was later determined Darwin was actually talking about genetic mutations, which are not aimed in any one direction (Bowler, 2009). Darwin rejected the notion that evolution occurred over time as a result of some predetermined developmental trend. Rather, he stated, evolution is the result of a naturally occurring sequence of events in which environmental forces contribute to the adaptation of a species over others. He called this sequence "natural selection."

Over time it became the consensus of organization theorists that the environment could influence the survival of individual organizations and that there are environmental forces that produce and shape populations of organizational forms (Mckelvey & Aldrich, 1983). Just as biological evolution of species is central to Darwin's theory of natural selection, organization theorists have suggested that processes within organizational environments are essential to the emergence of organizational forms and to the defining attributes of populations of organizations. These processes are variation, selection and retention (Hansenfeld, 1992).

Population Ecology Theory: Constructs

Population.

The population ecology theoretical framework enables researchers to understand changes in organizational forms based upon environmental factors and their impact on outcomes such as the financial and demographic disposition of organizational environments. Among the typical questions that organization theorists attempt to answer within the context of the population ecology perspective are “Why are there so many organizations?” and “What causes organizations to prosper or reduce?” The differences among organizations’ characteristics, environmental characteristics, and the probabilities of entry and exit have been the dominant empirical concern of population ecologists (Alexander & Amburgey, 1987).

The population ecology theory shifts the level of analysis from a single organization to a population of organizations. In this inquiry the pharmacist supply will be referred to as an organization. This approach has previously been utilized to understand factors affecting the physician supply in the U.S. (Jiang and Begun, 2002). Treating the pharmacist supply as an organization allows the ability to explore the factors affecting it within the population ecology framework. Organization theorists who employ the population ecology framework to describe how organizational forms emerge have made certain assumptions. Perhaps foremost among their assumptions is that populations of organizations can be defined in terms of Darwin’s natural selection thesis (Amburgey & Rao, 1996).

Along the same lines as Darwin’s concept of natural selection, organization theorists have pointed out that a longitudinal analysis is required to assess distributional relationships among organizational forms. Such analyses enable researchers to account for the effect of time on the emergence of organizational forms. The longer the period of time for which historical data are available, the more accurate the ecological picture (Alexander & Amburgey, 1987).

By extension of their logic for using longitudinal studies as the correct methodological approach to studying organizational forms and their emergence, organization theorists reject studies that employ cross-sectional data, or that use shorter time periods. Specifically, these latter two approaches are unable to adequately account for rare or uncommon occurrences, and thus, may lead the researcher to misinterpretations and to reaching incorrect conclusions. For these reasons, longitudinal studies are preferred among organization theorists. In light of this rationale, this inquiry seeks to explore and delineate the impact of environment on the pharmacist supply in the U.S. The fundamental premise here is that, as an organizational form, the pharmacist supply is actually the result of a process of natural selection in which the pharmacist supply is determined by environmental forces. In this regard, it is a premise of this inquiry that the collective characteristics of pharmacists and trends within the profession of pharmacy fit within the population construct of the population ecology framework.

Natural Selection.

Natural selection is the second construct in the population ecology theory. It is comprised of three components or stages: variation, selection and retention. Variation involves any kind of change or deviation in form, condition, appearance, or extent from a former or usual state or from an assumed standard; whether intentional or unintentional (McKelvey & Adrich, 1983). Variation in health manpower may involve formal recognition of new specialties or the emergence (or reemergence) of different forms for providing healthcare such as the use of physician assistants, nurse practitioners and pharmacy technicians (Rundall & McClain, 1982). Jiang and Begun (2002) declare that variation is a precondition for selection. Theirs is a sociological perspective of population ecology. Selection is the apparent predisposition of an organizational form for the environment in which it exists. In other words, the selection of an organizational form for its environment refers to its suitability for its environment as a result of prior variation.

Hannan and Freeman (1977) believe that very few organizations are able to change their structures quickly when faced with dramatic changes in. their environment. Organizations that are able to do so are selected over time and exhibit the fluidity that is required for them to adapt to a rapidly changing and sometimes complex environment. Once selected for their environment, organizations demonstrate stability and the ability to survive.

Hannan and Freeman further assert that organizational adaptation can best be understood in terms of being selected for multiple places (environments) as a result of natural selection versus being specifically and uniquely selected for a single environment. The difference between these two organizations or organizational forms is their properties. The properties of organizational forms are believed to be essential to an organization being selected for one or more environments. Hannan and Freeman see selection as an adaptive process. Looking at variation in the pharmacy workforce over time, one can see the various settings in which pharmacists now have increased presence, such as managed care organizations, wholesale industries and long-term care. This type of variation leads one to conclude that the pharmacist supply is suitable and likely to remain potent in the very volatile U.S. healthcare environment.

In this inquiry it is proposed to view the pharmacist supply as an organization poised to take its place within the larger healthcare system. The increasing specialization within the profession is an organizational form that predisposes it to survival in the volatile healthcare domain. As the organization's constituents (individual pharmacists) choose to become specialists, this collective action results in a new organizational form that is more suitable for the environment in which it operates. It is contended in this inquiry that the rate at which the organization changes is equal to the rate at which specialization within the profession is occurring.

In this vein, pharmacists selected for their environment will survive and thrive. Although the decision making process that leads pharmacists to practice in one environment versus another is beyond the scope of the present inquiry, it should be noted that the ultimate choice a pharmacist makes regarding practice venue may be a result of a number of factors including the healthcare workforce (number of other healthcare providers), socio-economics (insured population, employers based in vicinity), type of patients (elderly, young adults) and facilities (pharmacies, hospitals). All of these are important for survival or retention possibilities in a particular environment.

Niche.

The third construct in population ecology theory is niche. One of the important aspects of the environment with which a species must be concerned is other species. Each species needs a particular set of resources in order to survive and reproduce. This set of resources is their niche (Langston, 1987). When viewed as an organization, and in order to survive, pharmacists require a patient population, prescribers, a volume of prescriptions to be filled and an insured population. If one or more of these is missing, it is unlikely that the organization (pharmacists) will find its niche, and consequently would not be selected for that environment.

The extent to which two species will compete with each other is determined by two factors: their degree of niche overlap and the amount of resources available in the local environment (Langston, 1987). Niche overlap occurs when two species in the local environment require the same resources for survival and reproduction. When two or more species need the same amount or nearly the same amount of resources from their shared environment the competition between them will be intense. If one species manages to obtain the amount of resources they need they are more likely to be selected for the environment and will be able to survive. If neither of the species is able to achieve their niche, they may both disappear from the environment, unless they both undergo transformations that result in them becoming a single organization and as such are able to get the resources needed for survival.

In the present case it disputed that niche finding will not likely result in the disappearance of pharmacists. Rather, in organizational terms, it will affect the total population of pharmacists (number) and yield an organization that is suited for survival in the tumultuous healthcare environment. In the worst case scenario the size of the organization would diminish to the point that other health professions may perform functions that previously had been exclusively performed by pharmacists. This inquiry seeks to explore the dynamics of environmental factors that may affect the pharmacist supply over time and seeks to fill gaps in our knowledge regarding the pharmacist supply within the population ecology theoretical framework.

In this inquiry niche will be discussed within the context of the population ecology theory, but it will not be explored separately. Although niche overlap may be a significant factor in the pharmacist supply in the U.S. (e.g. mail order pharmacists vs. retail pharmacists), the data used in this inquiry are not sufficient to test this potential competitive relationship.

Carrying Capacity.

The fourth and final construct of the population ecology theory is carrying capacity. Carrying capacity is the population size that an area can support (Wholey & Sanchez, 1991). For example, the equilibrium number of organizations that can be supported in a specified area may depend on a community's size, wealth, and other demographic factors (Wholey & Sanchez, 1991). Hence, as an environment changes over time so does its carrying capacity.

The overall perspective of the population ecology theory is that the abundance or rarity of organizations and organizational forms may be discerned in terms of environmental surroundings (Namboodiri, 1994). Namboodiri contends that environmental conditions affect the rate of creation and extinction of organizations. The rate at which organizations change and the interactions that occurs within and among organizational populations constitutes the environmental surroundings. An analysis of populations possessing a unique character or attribute and of their environment is an extremely useful exercise for administrators and various decision makers because it facilitates strategic planning for the future.

Several studies in various industries have utilized the population ecology theory. Freeman and Hannan (1983) used it to study restaurants, Carroll (1984) used it to study the newspaper industry and Jiang and Begun (2002) used it in a study of the physician population. Nielsen and Hannan (1977) and Carroll (1981) also utilized the population ecology perspective to study economic resources affecting the growth of education organizations. The theory has been beneficial in research targeting the healthcare industry; particularly research looking at physician practice location and the environmental circumstances that help guide it.

The use of the population ecology theoretical framework in this inquiry is expected to fill in some of the gaps in our knowledge concerning the pharmacist supply. This inquiry will also provide a basis from which pharmacist leaders may be able to more effectively and optimally utilize environmental resources to ensure that sufficient numbers of pharmacists are available at all times to meet societal needs. Based on findings from this inquiry and previous inquiries, population ecology researchers may be able to develop and test more detailed models that address the pharmacist supply. The population ecology theory is considered one of the most abstract and broad perspectives on organizations. Although not necessarily rich in detail, it provides a critical basis for cumulative research (Bacharach, 1989).

Applying Population Ecology Theory to the Pharmacist Supply

The majority of the studies on the pharmacist supply in the United States have used time periods encompassing ten years or less. Two studies Mott et al. (2002) and Walton et al. (2004) applied a three year and ten year time frame, respectively, in their studies of the number of pharmacists. The final determination of the appropriate length of time for a study depends on the research question, circumstances, and variables involved. Variables that will be of importance for this inquiry include income, population composition and size of the insured population. Within the context of the population ecology theoretical framework, these variables describe the socio-demographic component of the environment. In this instance, these variables, among others, describe the socio-demographic component of the environment in which pharmacists ply their trade. Identifying and understanding the important variables and factors affecting the number of pharmacists in the U.S. may be extremely important in light of current and past discussions about reforming the U.S. healthcare system. Fryer, Green, Dovey, Yawn, Phillips, and Lanier (2003) suggest that income, population composition, size of the insured population and having a consistent source of care are important and helpful for conceptualizing system redesign in order to address healthcare disparities.

Population ecologists perceive the environment as a broad illustration of the resource pool from which organizations obtain their sustenance, thereby aiding in the organization selection process (Hurley & Kaluzny, 1987). Accordingly, this perspective recognizes that much of the ongoing change within the health services arena may be a function of necessity to achieve a better fit between resources and the environment (Hurley & Kaluzny, 1987). One example may be the growth of medical group practices and medical plans to better accommodate their population base. One area of research for many population ecologists is organizational mortality.

Researchers in this area have asserted that failures of organizations are due to causes external to them (Carroll, 1985). Along similar lines, variation in the pharmacist supply is believed to be a result of factors extrinsic to the profession of pharmacy. Using the population ecology framework, and consistent with the approach of population ecologists, the pharmacist supply may be seen in the same light as organizations. Consequently, the pharmacist supply is a result of the operation of environmental forces as well as certain preferences and characteristics of individuals who choose pharmacy as a profession. At various times the supply of pharmacists is inadequate and at other times it is adequate—in the former case not meeting the needs of the population and in the latter case meeting the needs of the population. Another popular focus of research by organization theorists is organizational transformation. Organizational transformation is a critical issue in health services delivery and can be examined using the ecological perspective.

The process of change in the healthcare arena can perhaps be more accurately and clearly understood when researchers use the population ecology theoretical framework to provide insights into the process of change (Hurley & Kaluzny, 1987). The study of organizational transformation usually includes three fundamental issues—rates of organizational founding, disbanding and change in a given population. Organizational founding is best explained in terms of two important concepts: density dependence and population dynamics.

An increase in organization volume (number of organizations in a particular geographical area) signals an increase in founding. At the same time, a larger number of organizations typically lead to more competition in the local environment and that results in disbanding.

Disbanding occurs when the environment cannot support the organization. For example, in the context of this inquiry, if the needs and expectations of the patient and provider populations do not create a demand for pharmacists and the tasks that they perform, the number of pharmacists will diminish.

The patient population here is synonymous with organizations that offer similar products. Insofar as the pharmacist supply is concerned, understanding founding (influx of pharmacists) and disbanding (decrease of licensed pharmacists available to provide services in the marketplace) are critical to recognizing and describing the cyclical patterns of rapid expansion and contraction that shape the pharmacist supply. Hasenfeld (1992) suggests that this is true across the board in the human services field.

The provider population also figures very prominently in this context, especially those providers whose usual breadth and scope of practice includes writing prescriptions for the medications that their patients require. One important observation here is that interdependence among organizations may increase the rate of founding and disbanding among organizations operating in the same environment.

By way of example, it is suggested here that both patients and providers depend heavily on reimbursements from insurance companies and other third parties to the healthcare transaction for the services provided and received in the healthcare marketplace. The availability or lack of availability of reimbursement will certainly affect the patients (causing limited access to care and their inability to obtain needed treatment) and their providers (causing them to restrict their practices or to cease to provide care to a segment of the population). These scenarios may be tied to the coming and going of employers in the area (because they typically are the entities that make insurance coverage available to their employees and they determine the extent and duration of coverage when it is provided). Therefore, as mentioned previously, an exploration of the pharmacist supply using the population ecology framework must include variables such as the number of insured persons, the number of employers, and the number of healthcare providers with prescribing authority.

Utilizing the population ecology framework to describe factors that impact the physician supply in America, Jiang and Begun (2002) noted that processes of change should be examined at the population level, rather than at the individual level. One implication of their work for explaining the supply of pharmacists is that the pharmacist supply is better understood by looking at macro trends among pharmacists and interactions with their environments as opposed to looking at the decisions, practices and environments of individual pharmacists.

It has been stated that a population is an aggregate of individuals that have a common dependence on the material and social environment (Freeman & Hannan, 1989). Examples of the material and social environment include facilities, prescriptions, physicians, and the patient population, where the pharmacist supply is concerned. These variables tend to fluctuate in an environment and are expected to have an impact on the number of practicing pharmacists (i.e., the pharmacist supply).

Consistent with Darwin's point of view, changes in the environment are expected to have similar effects on members (organizations) of a population. When this concept is applied to the health workforce, such as physicians who are generalists, or other health professionals such as nurses and pharmacists, these healthcare workers can be viewed collectively as a population. Hasenfeld (1992) states that there are two very important theoretical constructs that must be examined in research involving organizations and their environments: 1) openness of the organization toward its environment and 2) the degree to which the organization can control its own destiny. Organizations best positioned to take advantage of new environmental conditions will survive and reproduce through social, cultural, and institutional transmissions of beliefs and values, (Alexander & Amburgey, 1987).

Other observers have stated that the population ecology theoretical framework provides a useful perspective for examining the relationship between organizational transformation and organizational performance over time (Wischnevsky & Damanpour, 2006). The logic is that organizations that change at their core confront problems that are prevalent in new organizations. Hannan and Freeman (1984) believe that organizations are unable to change at the same pace as the environment due to structural inertia. Structural inertia is an organization's limited ability to adapt to its environment (Hannan & Freeman, 1977). In Hannan's and Freeman's view the faster and easier organizations adapt to their environments the more quickly they will achieve stability; thus ensuring their long-term survival. A summary of the studies that have been utilized in the development and study of the population ecology theory are provided in Table 2.

The following section the hypotheses that will be tested in this inquiry are presented. These hypotheses have been developed to provide the empirical foundation upon which this inquiry into the pharmacist supply in America is based and they are consistent with the population ecology theoretical framework that has been discussed in this chapter.

Hypotheses

Hypotheses H1 – H7 address the environmental dimension of munificence. Hypotheses H8 H12 address the environmental dimension of concentration and the final hypothesis (H13) addresses density-dependence. The data that will be used to test these hypotheses are described in the next chapter.

Table 2. Studies on the Creation and the Development of the Population Ecology

Key Points of Interest	Title	Reference
Species, environment, resources	Determining the survivability of species in relation to their environment	Darwin, 1859
Determination of changes in the U.S. hospital industry through the application of population ecology theory. The process of ecological selection rather than the transformation of individual organizations.	The Dynamics of Change in the American Hospital Industry: Transformation or Selection?	Alexander & Amburgey, 1987
Political Economy, Marxist Theory, Population Ecology Theory	Theoretical Approaches to Human Services Organization.	Hansenfeld, 1992
Key issues facing ecological research	Organizational Ecology: Past, Present, and Future Directions	Amburgey & Rao, 1996
Review of the population perspective with an outline for developing a classification of organizational forms. Suggestions on how to improve the application of organizational research.	Populations, Natural Selection, and Applied Organizational Science	McKelvey & Aldrich, 1983
A conceptual framework on physician distribution and forecasting regional physician supply. The study addresses an environmental selection model in which populations of physicians are viewed as the unit of analysis.	Environmental Selection and Physician Supply	Rundall & McClain, 1982
This study explores the physician supply based on population ecology theory, the framework attempts to explain the growth of a particular physician population by four mechanisms	Dynamics of change in local physician supply: an ecological perspective	Jiang & Begun, 2002
A population ecology perspective is assessed for its utility on organization to environment relations instead of the conventional adaptation perspective. There is a discussion on models that have attempted to discuss the organizational environment.	The Population Ecology of Organizations	Hannan & Freeman, 1977
An overview of human ecology is presented, with an ecological perspective on demography of households.	The Human Ecological Approach to the Study of Population Dynamics	Namboodiri, 1994
A model is developed to study environmental variability on populations of organizations is studied, specifically specialist and generalist organizations. This model predicts that death and growth rates of generalists and specialists in relation to environmental variation	Niche Width and the Dynamics of Organizational Populations	Freeman & Hannan, 1983
Educational organizations are assessed utilizing population ecology. It was found that the educational organizations and characteristics were dependent on the national environment abundance of resources.	The Expansion of National Educational Systems: Tests of a Population Ecology Model	Nielsen & Hannan,1977
A study of national systems of education and how they expand organizationally at varying speeds in different countries and time periods. The results suggest that organizational expansion in large, geographically decentralized systems follows a process dependent upon the limits of the environmental resources.	Dynamics of Organizational Expansion in National Systems of Education	Carroll, 1981

Munificence.

This scenario correlates with carrying capacity. Environmental resources important to the pharmacist supply include total resident population, number of physicians, number of pharmacies and hospitals and the financial viability of communities (e.g., median household income of residents). One would expect that as the resident population increases so does the patient population.

H1 There is a linear, positive relationship between a change in the size of the population and a change in the pharmacist supply over time.

While the size of the population may be important in determining pharmacist supply, the size of certain segments of the population may have a disproportionate effect on the need for pharmacists. Older residents utilize a disproportionate share of pharmacist manpower because they are more likely than their younger population counterparts to have chronic conditions that require pharmaceutical interventions (Kaiser Family Foundation, 2011). Older residents utilize a disproportionately higher number of prescribed medications than younger residents.
Hence, more pharmacists may be required in a community with a large proportion of older residents than in a similar community with the same proportion of young residents. The elderly consistently account for a majority of the prescriptions filled in many communities across the U.S.

H2 There is a positive, linear relationship between a change in the size of the elderly population and a change in the pharmacist supply over time.

Beginning in 2001 schools of pharmacy in the United States was required to have a curriculum leading to the Pharm.D. degree as the entry level degree for the profession. In addition, the profession experienced increased specialization among its practitioners. From a population ecology point of view, the survival of the profession would be dependent on the extent to which the environment in which pharmacists practice can accommodate more highly trained entry-level pharmacists and greater specialization among them. In particular, the profession must work to ensure that pharmacists are given the opportunity to use their skills on the job (Cox & Fitzpatrick, 1999).

There appears to be a disparity of opportunity to do so between community-based and institutional settings. Hospital-based pharmacists are more likely to have an opportunity to utilize their skills to the fullest extent possible compared to their community-based counterparts. In hospital and other institutional settings pharmacists are often members of medical teams providing a wide array of duties such as drug therapy and other clinical services for institutionalized patients.

H3 There is a positive, linear relationship between the number of hospitals with pharmacies and the pharmacist supply over time.

Pharmacists practice in a variety of environments including managed care organizations, academia, and industry. However, the majority of pharmacists work in pharmacies located either in a community (retail) setting or a hospital. Regardless of the setting, pharmacists perform a number of tasks essential to desirable, high quality patient care outcomes. Among these tasks are accuracy of order fulfillment, review of prescriptions for drug interactions and errors in drug selection and dosage, assistance with the selection of medications consistent with the ability of patients to pay for them, problem solving related to payment/reimbursement for filled prescriptions and answering patients' and other healthcare providers' general questions. Despite these facts, all too often, there is too little contact between pharmacists and patients.

The need for pharmacists may be greater in certain community/retail settings than in hospital or institutional settings. A number of previous studies have provided empirical evidence regarding the consequences of an insufficient number of pharmacists in the face of increasing demand (Mott, Doucette, Gaither, Pedersen, Kreling, & Schommer, 2006; & Knapp, et al. 2005). Some pharmacies have shortened their business hours, decreasing their accessibility to patients, while others (especially in rural communities) have closed because a replacement could not be found for a retiring pharmacist (Manasse & Speedie, 2007).

H4 There is a positive, linear relationship between the number of pharmacies and the pharmacist supply over time.

Another important factor pertaining to munificence where the pharmacist supply is concerned is the volume of prescriptions filled. The writing of a prescription is one of the most common, and important, therapeutic interactions between physicians and their patients. About three billion prescriptions were dispensed in 2001 by more than 136,000 full-time equivalent (FTE) pharmacists.

According to Pal (2002) those three billion prescriptions amounted to approximately 30,000 prescriptions /pharmacist/year. Based upon current trends and annual growth rates it is estimated that approximately 7.2 billion prescriptions will be written to be filled in 2020; or about 90,000 prescriptions/pharmacist/year (Pal, 2002). This projection appears to be reasonable and tenable in light of the fact that approximately 4 billion prescriptions were dispensed in 2010 (Kaiser Family Foundation, 2011). Pal estimates that an additional 80,000 to 100,000 FTE pharmacists will be needed by 2020 to meet such a great prescription demand.

H5 There is a positive, linear relationship between the number of prescriptions filled and the pharmacist supply over time.

According to one national survey, physicians wrote over 4 billion prescriptions in 2007. Physicians are responsible for the majority of the prescriptions written in the U.S.(Medical Expenditure Panel Survey, 2008). To keep this in perspective, there were approximately 1.5 billion physician office visits in 2008, with approximately 20% of those visits resulting in patients leaving with at least one prescription (Medical Expenditure Panel Survey, 2010). Studies have revealed that there has been a consistent increase in both the physician and pharmacist workforce populations in recent years (Shih, 1999; DHHS, 2006; DHHS, 2008). Empirical findings reported by these studies seem to support the notion that the pharmacist supply increases to match the demand for more prescriptions to be filled by an increasing number of physicians.

H6 There is a positive, linear relationship between the size of the physician supply and the pharmacist supply over time.

The affluence in an environment gives rise to the ability to afford healthcare. Communities that are relatively wealthy are better able to afford healthcare compared to communities that are not doing as well financially. A healthcare quality survey was conducted by Weinwick, Byron, and Bierman (2005) to collect detailed information about experiences with healthcare from a nationally representative sample of 6,722 adults ages 18 and older living in the continental United States. Approximately 16.9% of those included in the survey said they had postponed care, not filled prescriptions, used alternative care, or engaged in other noncompliant behavior as a result the exorbitant cost of healthcare and their inability to afford it. This statistic lends itself to the notion that people with higher levels of income tend to purchase more healthcare, all other factors being equal (Sing, Miller, & Banthin, 2008).

H7 There is a positive, linear relationship between the wealth of a community and the pharmacist supply over time.

Concentration.

Concentration describes the level to which resources are distributed. In the healthcare arena the organizations and entities that impact the distribution of resources include pharmacies, hospitals, physicians, and employers. In the case of hospitals, the distributions of these facilities affect pharmacists' options regarding where they are going to work. Hospitals that are involved in mergers may be participating in consolidation across markets that have no customer overlap (Ho & Hamilton, 2000). Increasing mergers of hospitals in an area may lead to improvements in services such as pharmaceutical services (Brooks & Jones, 1997). Hospitals in more competitive markets have a greater probability of mergers and acquisitions, but not closures; which increases market power (Ho & Hamilton, 2000).

Based upon a study by Dasatani & Siganga (2003) the greatest effects that mergers and strategic alliances were expected to have on pharmacists' duties and responsibilities is an increase in clinical duties, administrative duties, and an increase in patient-monitoring duties. Pharmacy directors also indicated that there would be increases in inpatient and outpatient drug distribution duties (Dasatani & Siganga, 2003).

Hospitals with a strong market share have the ability to promote the provision of tertiary care services, this leads to an increase in occupied beds in a facility. This in turn increases the demand for pharmacists who are integral in drug therapy for patients. The importance of clinical pharmacists to hospitals cannot be understated; their roles have increased with emphasis on collaborative care and patient interaction (Kaboli, Hoth McClimon, & Schnipper, 2006). The ASHP conducted a national survey, which ended in 2000 on pharmacy practices in hospitals.

The number of pharmacists involved in monitoring increased to 84% of hospitals in the 2008 survey with larger bedded hospitals employing a greater number of pharmacists (Pederson, Schneider, & Scheckelhoff, 2009). This number increased to over 93% of the hospitals surveyed with 200 beds or more reported having their clinical pharmacists actively involved in monitoring patients (Pedersen, Schneider, & Scheckelhoff, 2012). The hypothesis proposed applies to hospital beds and its impact on the pharmacist supply.

H8 There is a positive, linear relationship between hospital beds per 100,000 population and the pharmacist supply over time.

Some regions of the country may have higher volumes of pharmacies based upon the demand of their population. States with large elderly populations may have more pharmacies and may have a larger volume of prescriptions filled annually than states with smaller elderly populations.

Chain pharmacies employ nearly 118,000 full-time equivalent (FTE) pharmacists (NACDS, 2011). More community pharmacies in a state may provide more potential work opportunities for pharmacists and more desirable benefits such as flexible schedules, upward mobility and l higher salaries. Marketplace factors have a greater impact on the number of community pharmacies than geography (Christensen & Farris, 2006). There are approximately 55,400 community pharmacies in the U.S., More than 50% are members of chains and the remainders are independently owned. Chain pharmacies fall into the following categories: traditional chains (e.g. CVS), mass merchandisers (e.g. Walmart), and supermarket pharmacies (e.g. Safeway) (Christensen & Farris, 2006). Chain pharmacies operate approximately 39,000 pharmacies and fill nearly 2.6 billion prescriptions annually, which are more than 72% of annual prescriptions in the United States (NACDS, 2011). The majority of currently employed pharmacists work for community pharmacies.

H9 There is a positive linear relationship between the number of pharmacies per 100,000 people and the pharmacist supply over time.

The numbers of physicians practicing in states across the U.S. vary as a result of many factors. These factors include practice environments and preferences for their personal lives. Insofar as practice environments are concerned, factors affecting a physician's decision to establish a practice in a certain location include specialty, academic and healthcare resources and patient population. Outside of the office physicians desire good neighborhoods for their families, good schools and a wide selection of leisure activities. According to one study utilizing economic theory, physicians locate both in previously underserved smaller communities, as well as in locations where their colleagues are already practicing in an attempt to balance their patient loads (Rosenthal, Zaslavsky, and Newhouse, 2005). Physicians are primarily responsible for almost all of the prescriptions that are written in the United States.

According to a study by Cherry et al. (2007) physicians wrote two billion prescriptions during office visits in 2005. Physicians also write prescriptions in hospitals, long-term care facilities and governmental agencies. When physicians are part of a larger physician network they tend to be more concentrated geographically. The vicinity in which physicians practice lends itself to the potential for a certain volume of prescriptions being generated, thereby leading to a specified need of pharmacists to meet the rising demands.

H10 There is a positive linear relationship between the number of office based physicians per 100,000 population and the pharmacist supply over time.

Employers are a principal source of healthcare benefits for the general population. Recent estimates from the United States Chamber of Commerce suggest that United States companies spend approximately $0.11 of every payroll dollar on healthcare benefits (Abraham, Feldman, Carlin, Christianson, & Davis, 2005). Employers play a key role as purchasers and administrators of health insurance for the working-age population in the United States. In 2003, approximately 174 million Americans (60.4% of the U.S. population) obtained their health insurance through an employer (Denavas-Walt, Proctor, & Mills, 2004).

Nearly 60% of people with employer-sponsored health insurance coverage obtain it through a very large employer (500 or more employees). Slightly more than one in four persons with employer-sponsored health insurance coverage obtained it through a small employer (fewer than 100 employees) (State Health Access Data Assistance Center [SHADAC], 2011). With this in mind it can be surmised that employers wield a considerable amount of buying power in the healthcare arena, and consequently, may substantially impact the pharmacist supply.

H11a There is a positive linear relationship between the number of employers and the pharmacist supply over time.

H11b1 There is a positive linear relationship between employer size (19 or less employees) and the pharmacist supply over time.

H11b2 There is a positive linear relationship between employer size (20 or more employees) and the pharmacist supply over time.

In the past decade, prescription drug utilization and spending in the United States has increased dramatically (Reed, 2005). One study of Medicare beneficiaries reported that drug coverage was associated with a 9.6% increase in the probability of any prescription use (Huh, Rice, and Ettner, 2008). One review of studies examining the implementation of Medicare Part D found that there has been a 6% to 13% increase in reported drug use since its implementation (Geib, 2007). Ostensibly, increased utilization of medication benefits leads to an increased prescription workload for pharmacists, which may exceed the capacity of the pharmacist supply (Geib, 2007). In addition to the increased number of Medicare beneficiaries obtaining prescription access through Medicare Part D; by 2014 approximately 32 million Americans who are currently uninsured will gain access to healthcare benefits including coverage for prescription drugs through some form of insurance (Vivian, 2010).

Provisions of the Affordable Care Act of 2010 are expected to play a very significant role in the increase of the number of insured Americans by 2014. The most prominent outcome of a larger percentage of persons having coverage for prescription drugs is likely to be an increased volume of prescriptions being written, which will increase demand for more pharmacists and pharmacy personnel (Vivian, 2010).

H12 There is a positive linear relationship between the number of insured and the pharmacist supply over time.

Density Dependence.

Complete data on interactions between organizations in a community are generally not available. Ecologists have therefore relied on the indirect evidence provided by the estimated effects of population density (the number of organizations in a population) on vital rates (founding and mortality) (Staber, 1992). Population ecologists study competition and symbiotic relationships and their outcomes in an attempt to discover and describe density dependence.

According to Hannan & Freeman (1977) the rate at which units are added to populations of organizations depends on how much of the fixed capacity has already been exhausted. The greater the unexhausted capacity in an environment, the faster should be the rate of growth of populations of organizations. There are two distinctive ecological considerations: the capacity of the environment to support forms of organization and the rate at which the populations grow (or decline) when the environmental support changes. This lends itself to the understanding that competition grows with density at an increasing rate. The pharmacist supply is believed to also be susceptible to environmental competition. If there is an oversaturation of pharmacists at any given point this may impede the future growth of the pharmacist supply.

Organizational forms presumably fail to flourish in certain environmental circumstances because other forms successfully compete with them for essential resources. As long as the resources which sustain organizations are finite and populations have unlimited capacity to expand, competition must ensue (Hannan & Freeman, 1977). With this notion of potential finite resources, it is imperative to assess the pharmacist supply while accounting for density. Staber (1992) asserts that a current population's growth rate must be taken into account in order to clearly understand how density dependence may alter this population's growth rate as density changes; otherwise the population projections may be deceptive. The Population Ecological Framework and hypotheses for this inquiry are listed in Figure 2 and Table 3, respectively.

H13 Is there a change in the total number of pharmacist's overtime.

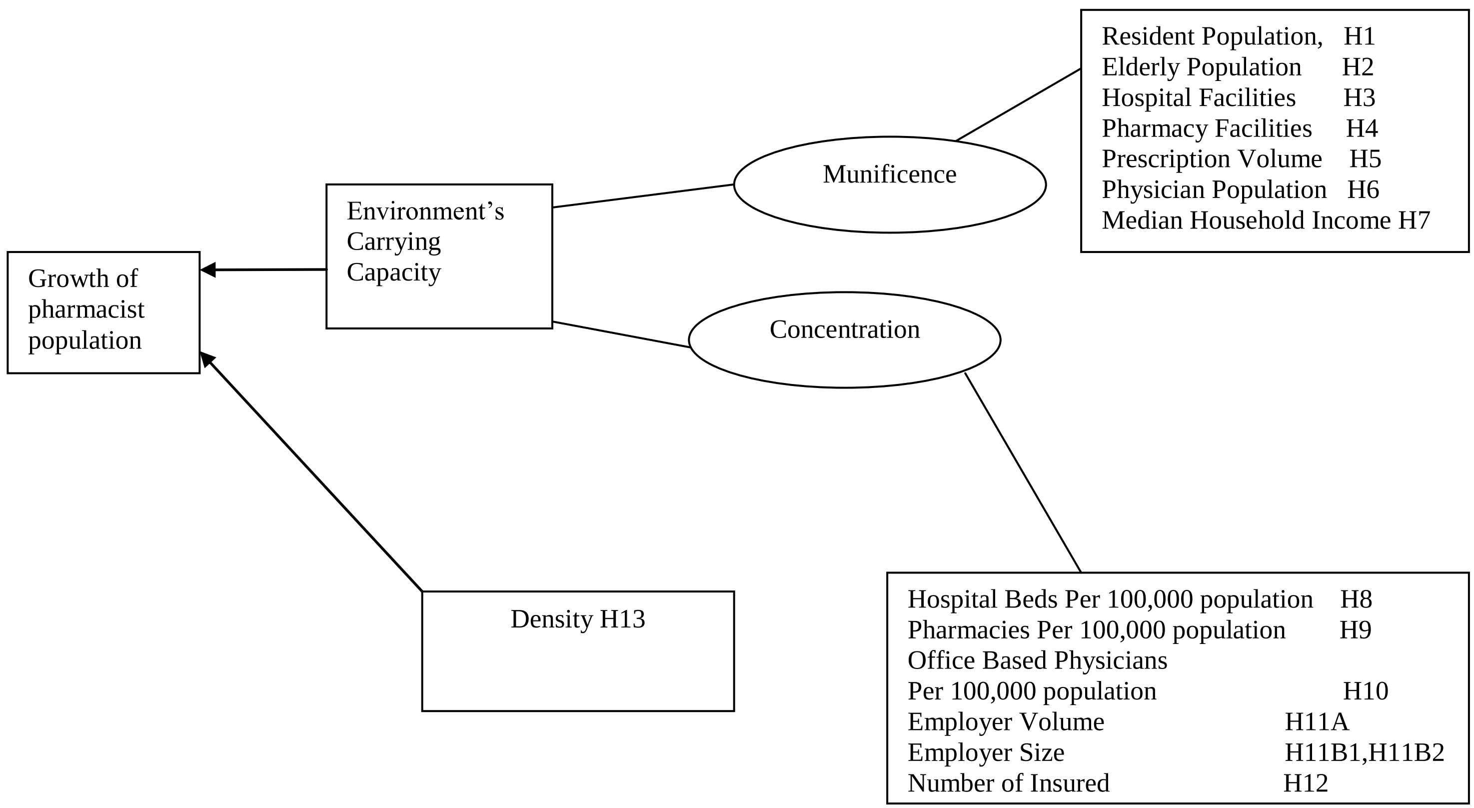


Figure 2. Pharmacist Supply and the Ecological Spectrum of the Hypotheses

Table 3. Hypotheses

H1	There is a positive linear relationship between a change in the size of the and a change in the pharmacist supply over time.
H2	There is a positive, linear relationship between a change in the size of the elderly population and a change in the pharmacist supply over time.
H3	There is a positive, linear relationship between the number of hospitals with pharmacies and the pharmacist supply over time.
H4	There is a positive, linear relationship between the number of pharmacies and the pharmacist supply over time.
H5	There is a positive, linear relationship between the number of prescriptions filled and the pharmacist supply over time.
H6	There is a positive, linear relationship between the size of the physician population and the pharmacist supply over time.
H7	There is a positive, linear relationship between the median household income and the pharmacist supply over time.
H8	There is a positive, linear relationship between hospital beds per 100,000 population and the pharmacist supply over time.
H9	There is a positive linear relationship between the number of pharmacies per 100,000 people and the pharmacist supply over time.
H10	There is a positive linear relationship between the number of office based physicians per 100,000 population and the pharmacist supply over time.
H11a	There is a positive linear relationship between the number of employers and the pharmacist supply over time.
H11b1	There is a positive linear relationship between employer size (19 or less employees) and the pharmacist supply over time.
H11b2	There is a positive linear relationship between employer size (20 or more employees) and the pharmacist supply over time.
H12	There is a positive linear relationship between the number of insured and pharmacist supply over time.
H13	Is there a change in the pharmacist supply overtime.

Chapter 4: Methodology

This inquiry examines the impact of environmental factors on the pharmacist work force in the United States. A review of the relevant, extant literature was presented in chapter two. The theoretical framework for this inquiry was presented in chapter three. In this chapter an overview of the study design, the data and the procedures and techniques for analyzing the data are presented.

Study Design

A non-experimental cohort design will be used to examine the effects of changing environmental conditions on the pharmacist supply. This study design is appropriate for studying a subset of a population over time (Polit & Beck, 2004). The time frame for this inquiry covers the 16 years between 1994 and 2009. During this period there was a significant and noteworthy shift in the accreditation process for U.S. schools of pharmacy. All schools of pharmacy were required to make the transition from the B.S. degree as the entry level professional degree to the Pharm.D. degree as the entry level degree for the profession. This change and the widespread implementation of the standardized curriculum leading to the Pharm.D. degree is beyond the scope of this inquiry.

However, the mandatory transition from the B.S. to the Pharm.D. degree is an important environmental factor that is believed to have significant, discernible impact on the pharmacist supply during the time frame for this inquiry and should be examined in a separate inquiry.

Determining an appropriate length of time to examine the pharmacist supply is a challenge. Findings from a majority of previous studies addressing the issue of the pharmacist supply were based on a time frame of fewer than 10 years (Gershon, Cultice, & Knapp, 2000; Walton, Cooksey, Knapp, Quist,& Miller, 2004). This inquiry will be utilizing a timeframe from 1994 – 2009, with some variables being tested on a slightly shorter timeframe based on data not being available for the entire timeframe. A table depicting all variables and timeframe available is presented later in this chapter.

Lotka-Volterra Model

A good proportion of the previous research on the population ecology of organizations has relied on models of multiple populations. Such models capture population growth and decline. Most frequently, these models are multivariate extensions of the logistic model commonly referred to as the Lotka Volterra (LV) model (Carroll, 1985). The LV model, developed by American physical chemist Alfred Lotka and Italian mathematician Vito Volterra, attempts to describe the dynamics of biological systems in which two species interact.

The use of LV equations was initially advocated by Hannan & Freeman (1977) for use in studies involving populations of organizations. Since their use by Hannan and Freeman, these models have been used in additional studies involving various professions and professional organizations (Carroll, 1981; Wholey & Brittain, 1986).

The LV equation has become the basis of modern-day population ecology, although some consider it to be of limited practical utility for complex organizations. Today, LV equations are regarded for their instructive value, rather than their applied utility (Dorschner, Fox, Keener, & Eikenbary, 1987). The LV equation will provide the methodological and conceptual framework for this inquiry. The change in size of the pharmacist supply between 1994 and 2009 will be examined using the LV equation. The LV equation will be particularly useful for exploring the two population ecology dimensions as they relate to the pharmacist supply: munificence and concentration. The adaptation of the LV equation for this inquiry is represented by the following equation.

$$\frac{dN_i}{dt} = r_i N_i \left(\frac{K_i - N_i - \sum_{j \neq i}^{J} - \alpha_{ij} - N_i}{K_i} \right)$$

N_i= number of organizations in population *i*, K_i = environmental carrying capacity for population *i*, r_i= growth response parameter for population *i* (i.e. the speed with which the population grows in the absence of competition),α_{ij}= the interdependence coefficient, which is the effect of population *j* on *i* (Jiang and Begun, 2002). This specification describes the growth rate of an organization or population. The growth is influenced by population size relative to the environmental carrying capacity for the population (Baum & Singh, 1994).

Model Specification

Munificence (M) and Concentration (C) are two environmental factors that help determine the pharmacist carrying capacity. The munificence dimension will be measured using the following variables: patient population, hospital facilities, pharmacy facilities, prescription volume, physician population, and community wealth. The concentration dimension will be measured using hospital beds per 100,000 population, pharmacies per 100,000 population, office based physicians per 100,000 population, employer volume, employer size, and number of insured. Munificence and concentration vary with time and cannot be observed directly. However, these dimensions are useful for determining and specifying resource availability. The following model and formulas will be utilized to explore the pharmacist supply over time.

$P_{jk} = ß_0 + ß_{1j}* year_j + ß_2 + \alpha_k + E_{jk}$ Where j= 1994-2009

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **Pop**$+ \alpha_k + E_{jk}$ Where **Pop** = Total population

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **Pop 65**+ $+ \alpha_k + E_{jk}$ Where **Pop 65**+= Total number over 65 in the population

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **Hosp**$+ \alpha_k + E_{jk}$ Where **Hosp** = Total number of hospitals

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **PharmF**$+ \alpha_k + E_{jk}$ Where **PharmF** = Total number of pharmacies

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **Rx**$+ \alpha_k + E_{jk}$ Where **Rx** = Total number of prescriptions filled

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **Dr** $+ \alpha_k + E_{jk}$ Where **Dr** = Total number of physicians

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **MHI** $+ \alpha_k + E_{jk}$ Where **MHI** = Median Household Income

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **HospC**$+ \alpha_k + E_{jk}$ Where **HospC** = Number of hospitals per 100,000 population

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **PharmFC**$+ \alpha_k + E_{jk}$ Where **PharmFC** = Number of pharmacies per 100,000 population

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **OBDR** $+ \alpha_k + E_{jk}$ Where **OBDR** = Number of office based physicians per 100,000 population

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **EmpV** $+ \alpha_k + E_{jk}$ Where **EmpV** = Total number of employers

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **EmpS**1$+ \alpha_k + E_{jk}$ Where **EmpS**1 = Total number of employers by size (0-19 employees)

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **EmpS2**$+ \alpha_k + E_{jk}$ Where **EmpS2** = Total number of employers by size (20+ employees)

$P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **Ins**$+ \alpha_k + E_{jk}$ Where **Ins** = Total Number of Insured

P_{jk} represents the pharmacist supply as it interacts with the environment. The parameter $ß_{0i}$ is the intercept term; it is a baseline estimate according to the model. The parameter $ß_{1j}$ represents the relationship between year and the pharmacist supply. $ß_{2j}$ is the relationship between the pharmacist supply and the current variable. α_k represents random effects in the model. E represents the error term within the model. This is a mixed effects model and it takes into account both fixed and random effects.

Data

For the purposes of this inquiry, the pharmacist supply will be the unit of analysis. The pharmacist supply is defined as the total number of licensed pharmacists at a point in time. Data for this inquiry come from a number of sources and are supplied on a state by state basis. In order to effectively assess the environment's impact on the pharmacist supply, data will be drawn from several sources. The first source is the National Association of Boards of Pharmacy (NABP). Founded in 1904 the NABP is a professional organization that supports the state boards of pharmacy in protecting public health.

The NABP's member boards of pharmacy are grouped into eight districts that include all 50 United States, the District of Columbia, Guam, Puerto Rico, the Virgin Islands, eight Canadian provinces, and New Zealand. The Association is governed by its Executive Committee, whose officers and members are elected at an annual conference. The data that are compiled by the NABP are produced by the Survey of Pharmacy Law Census. The survey describes and summarizes how the state boards of pharmacy are organized, how they function, and their requirements for licensure.

There are limited options for obtaining pharmacist and pharmacy data. The NABP is perhaps the most suitable source for such data. The NABP receives its data from each state's board of pharmacy. When pharmacists and pharmacies apply for licensure to their state's board of pharmacy, certain information is collected and added to a database. The NABP collects the databases from each state and assembles a master database of pharmacist and pharmacy data that may then be used in research such as this inquiry.

One limitation of using NABP data is that practice location is determined from professional mailing addresses. However, the state of residence may not necessarily indicate the state in which a pharmacist practices. A licensed pharmacist may work in a state that borders his/her state of residence. At this juncture, the NABP provides the most comprehensive data available on the pharmacist supply and pharmacy demographics.

The Area Resource Files (ARFs) are the second source of data for this inquiry. Quality Resource Systems, Inc. (QRS) maintains the ARF System under contract from the Health Resources and Services Administration of the U.S. Dept of Health and Human Services and has maintained and expanded the database for the past fifteen years.

The database contains data from many sources including the American Hospital Association, the American Medical Association, the Centers for Medicare and Medicaid Services, the National Center for Health Statistics, and the Census. The database is an annually-updated file with over 6,000 variables of interest that pertain to health facilities, health professions, measures of resource scarcity and socioeconomic and environmental characteristics.

ARF data used in this inquiry include number of hospital facilities and number of licensed physicians. The AMA data on physician workforce in the ARF contains data on all doctors in the United States who have completed or are completing requirements to practice medicine. This number includes graduates of foreign medical schools who reside in the United States as well as doctors of osteopathy who have met the educational and credentialing requirements necessary for licensure. The one main limitation, as with the NABP data, is that a physician's state of residence may not necessarily indicate the state in which he or she practices medicine. The AHA is the national organization that represents and serves all types of hospitals and is comprised of nearly 5,000 member hospitals. The AHA database contains hospital-specific data obtained annually through a survey of hospitals in the United States. Hospital specific ARF data include an analysis of trends and data on personnel, resource utilization, budgets, and bed size.

The third data source for this inquiry is the National Association of Chain Drug Stores, which represents traditional drug stores, supermarkets, and mass merchants with pharmacies from regional chains with four stores and national companies. The chains operate 39,000 pharmacies, and employ approximately 118,000 full-time pharmacists, and fill nearly 2.6 billion prescriptions annually, which are more than 72% of annual prescriptions in the United States (NACDS, 2011).

The prescription data utilized by NACDS is compiled by Wolters Kluwer Health, which is an organization that has been around for over 170 years and provides important information to global and national pharmacy professionals and the pharmaceutical industry. Wolters Kluwer Health obtains electronic drug data and clinical information from more than 20,000 pharmacies, 2,000 hospitals, and numerous health insurers and physicians' offices. Prescription fill data used in this inquiry will come from the NACDS database.

The fourth data source for this inquiry is provided by the U.S Department of Commerce which promotes job creation, economic growth, and sustainable development and improved standards of living for all Americans by working in partnership with businesses, universities, communities and our nation’s workers. The U.S Department of Commerce collects information on employers throughout the United States based upon County Business Patterns. The department compiles data from an annual report that contains data on budgetary projections, market potential and sales quotas over time. Businesses utilize the data for analyzing market potential, measuring the effectiveness of sales and advertising programs, setting sales quotas, and developing budgets. The data on the number and size of employers per state will be obtained from the U.S Department of Commerce and utilized in this study.

The fifth and final data source that will be utilized is provided by the U.S. Census Bureau. The Census Bureau is an agency within the U.S. Dept of Commerce and is the premier source of quality data about the nation's population and economy. The Census Bureau collects a variety of data about the U.S. population and various subpopulations. The census also collects and analyzes data pertaining to median household income and insurance status.

Sampling

Unless otherwise noted, the data used in this inquiry are derived from the entire population or sub-population of interest. No sampling will be used in this inquiry. However, it should be noted that data obtained from some of the sources mentioned above may be obtained from samples as indicated by the data owner. Analyses will be performed using the data provided by the sources above.

Study Variables

The following variables will be used in this inquiry; in some instances a few of these variables have been utilized in previous studies that have used the population ecology theoretical framework to examine environmental factors impacting the supply of health professionals. A description of the variables can be found in Table 4.

Dependent Variable.

The dependent variable for this inquiry is the pharmacist supply in the United States. For the purposes of this inquiry the pharmacist supply will be the total number of pharmacists in the United States in a given year. The total number of pharmacists for each state is based on data reported by the NABP. To prevent duplication and over counting, only those pharmacists with addresses within their reported state of residence are counted in the state totals. The majority of the studies that have looked at pharmacist supply have used national data from the U.S. Census Bureau. However, the data from the Pharmacy Census produced by the NABP is the most accurate data to measure the number of pharmacists by state because the NABP data are derived from the actual data submitted by each state pharmacy board; compared to the estimates from the U.S. Census Bureau Survey.

Independent Variables.

- Total population. is a variable obtained from the Census and will be all encompassing of the population from babies to the elderly by state.
- Elderly population. is a subset of the total population and is provided by the Census and will be based upon the population that are 65 years and older and will be compiled by state.
- Hospitals. is based upon facilities who are members of the AHA. The data utilized for this study will be compiled on a state by state basis for all AHA hospitals and is located within the ARF.
- Pharmacies. Data will cover all pharmacy settings from retail pharmacies to institutional pharmacies. This data is supplied by the NABP and provides the total number of pharmacies for each state based upon all the licensures requested.
- Prescriptions filled. The volume of prescriptions data are provided by the NACDS in collaboration with Wolters Kluwer Health Source which is the primary source for filling prescriptions throughout the United States. The data is compiled on a state by state basis
- Physicians. The data for this variable is provided by the AMA and is subject to licensed practitioners on a state by state basis, and is contained within the ARF.

- Median Household Income. The Median Household Income for each state will be measured upon the median house hold income provided by the Census Bureau.
- Hospital Beds Per 100,000 population. The data is measured on the number of hospital beds per 100,000 population. The data utilized for this study will be retrieved from the AHA and the Census Bureau located within the ARF.
- Pharmacies per 100,000 population. The data is measured on the number of community pharmacies per 100,000 population. The data utilized for this study will be retrieved from the NACDS and the Census Bureau.
- Office Based Physicians Per 100,000 population. The data is measured on the number of licensed practitioners practicing in an office setting per 100,000 population. The data is provided by the AMA contained within the ARF and the Census Bureau.
- Employer Size. The data is provided by the United States Commerce. The data represents the total number of employers that employ a certain number of people it is categorize by a specified employee range.
- Employer Volume The data is provided by the United States Commerce. The data represents the total number of employers by state.
- Insured Population. The data is based upon the total number of insured (public & private) by state and is provided by the Census Bureau.

Analytic Methods

Univariate Analysis.

Descriptive statistics will be computed for each variable. The simple means of each variable and the standard errors will be provided.

Multivariate Analysis.

A Repeated Measures Regression Analysis will be used to test the hypotheses presented in this study. Repeated Measures Regression Analysis employs a mixed effects regression model and is able to account for the impact of covariates on the dependent variable (Brown and Prescott, 2006). In the present case, year is a covariate of the pharmacist supply. The presence of missing data does not pose the major problems for analysis that can occur with traditional regression analysis (Brown & Prescott, 2006). Another benefit of repeated measures regression is its ability to reveal trends over time as opposed to single point estimates of changes in the dependent variable. The variable descriptions are listed in Table 4.

Table 4. Variable Definitions

Variables	Variables Abbreviation	Levels	Dates	Description	Source
# of Pharmacists	Pharm	Continuous	1994-2009	Total # of Pharmacists with in state addresses	NABP
Employer Size	EmpS1, EmpS2	Continuous	1988-2008	Total # of Employers by Employee Size: 0-19,20 or more	Census
Employer Volume	EmpV	Continuous	1988-2008	Total # of U.S. Employers by State	Census
# of Pharmacies	PharmF	Continuous	1994-2009	Total # of Pharmacies by State	NABP
Total # of U.S. of Hospitals	Hosp	Continuous	1995-2007	Total # of U.S. Hospitals by State	ARF
# of Prescriptions	Rx	Continuous	1996-2009	Total # of Prescriptions Filled By State in Chain Drug Stores	Wolters Kluwer Health Source
Total # of U.S. population Insured by State	Ins	Continuous	1994-2009	Total # of U.S. population Insured by State	Census
# of U.S. people over 65 years old by State	Pop 65+	Continuous	1994-2009	Total U.S. Population Over 65 years of age by State	Census
Total U.S. Population by State	Pop	Continuous	1994-2009	Total U.S. Population by State	Census
# of Physicians	Dr	Continuous	1994-2008	Total # of Physicians with in State addresses	ARF
Median Household Income	MHI	Continuous	1994-2009	Median Household Income by State	Census
Hospital Beds Per 100,000 population	HospC	Continuous	1995-2007	Number of Hospitals Per 100,000 population	ARF & Census
Pharmacies Per 100,000 population	PharmFC	Continuous	1994-2008	Number of Pharmacies Per 100,000 population	NACDS & Census
Office Based Physicians Per 100,000 population	OBDR	Continuous	1995-2008	Number of Physicians Per 100,000 population	ARF & Census

All Figures are summed across all states unless noted otherwise.

Chapter 5: Results

This chapter will present the results of the analysis on the environmental factors affecting the pharmacist supply in the U.S. A descriptive summary of the data is provided in the first section of the chapter. Table 5 provides the change in pharmacist supply from year to year; in appendices D-F the changes in the independent variables from year to year are displayed. Table 6 displays the descriptive statistics of all the variables being utilized in this study including the timeframe of the data available. The second section of the chapter presents the results of each hypothesis in the context of its construct association. In addition, there is a summary of each construct in relation to the results of all the variables. The last section of the chapter provides a summary of the findings based upon the results of the hypothesis testing utilizing the repeated measures regression analysis.

Descriptive Statistics

Changes in the Pharmacist Supply Between 1994 and 2009.

Between 1994 and 2009 the number of licensed pharmacists in the U.S. grew from 181,134 to 264, 527; an average 2.5% increase per year during this 16 year period (NACDS, 2011). The dependent variable for this inquiry is the total number of licensed pharmacists with instate addresses., this provides more of an accurate count considering a pharmacist may have several state licenses for practicing pharmacy.

As Table 5 indicates, the supply was the greatest in 2008 and least in 1994. During the 16 year period of this inquiry, on average, there were 224,301 licensed pharmacists with instate addresses in the U.S., i.e. approximately 79 per 100,000 population. Table 6 illustrates the descriptive statistics of the independent and dependent variables.

Table 5. Percentage Change in Pharmacist Supply Per Year, 1994-2009

Year	# of Pharmacists	% of Change
1994	181134	
1995	185818	3
1996	198053	6
1997	201084	2
1998	201590	0
1999	206002	2
2000	197678	-4
2001	216248	9
2002	218609	1
2003	236009	7
2004	246392	4
2005	247560	0
2006	254566	3
2007	264490	4
2008	269066	2
2009	264527	-2

Table 6. Descriptive Statistics for Study Variables

Variables	Mean	Median	Minimum	Maximum	Standard Error	Timeframe
Dependent Variable						
Pharm	224,301.6	217,428.5	181,134.0	269,066.0	7513.38	1994-2009
Independent Variables						
Munificence						
Pop	284,153,822.8	286,582,792.5	260,348,536.0	307,006,550.0	3950694.7	1995-2008
Pop 65+	36,159,035.4	35,947,903.5	33,208,822.0	39,570,590.0	419026.9	1994-2009
Hosp	6,429.7	6,346.0	6,285.0	6,641.0	52.1	1995-2007
PharmF	77,667.6	74,918.0	68,130.0	87,246.0	1650.8	1994-2009
Rx	2,991,969,779.9	3,061,141,763.0	2,211,372,768.0	3,658,892,270.0	122064017.2	1996-2009
DR	757,028.9	765,474.0	623,403.0	848,933.0	18484.1	1994-2008
MHI	50,153.9	50,616.1	46,399.1	52,138.1	429.8	1994-2009
Concentration						
HospC	377.1	367.8	356.1	446.8	9.4	1995-2007
PharmFC	30.1	29.6	27.8	33.2	0.4	1994-2008
OBDR	178.2	180.6	157.0	187.8	2.8	1995-2008
EmpV	7,129,851.2	7,095,302.0	6,509,065.0	7,705,018.0	97276.1	1988-2008
EmpS1(Employers with 19 or less employees)	4,610,787.7	4,376,391.0	4,115,583.0	5,466,985.0	131812.4	1988-2008
EmpS2 (Employers with 20 or more employees)	2,519,063.5	2,588,372.0	2,090,551.0	2,882,961.0	64963.1	1988-2008
Ins	239,895,687.5	242,307,500.0	222,418,000.0	255,141,000.0	2898134.2	1994-2009

These descriptive statistics represent the mean for the totals of the years specified above.

Variable Overview

Population (Pop) The U.S. population grew by approximately 2-3 million people per year during the period 1994 through 2009. In the last several years of the timeframe, the population grew by 3 million people per year. On average, over 284 million people lived in the U.S. between 1994 and 2009. In 2009 the U.S. population reached 307 million people.

Elderly Population (Pop65+) Persons 65 years old and older comprise one of the fastest growing segments of the U.S. population. During the 16 year period for this inquiry, this segment of the U.S. population grew by six million (16%). This segment of the population accounts for a disproportionately higher share of prescription drug use and is expected to continue to grow at a faster rate than the rest of the population as a result of the continual development of new medications to treat chronic conditions

Hospitals (Hosp) The number of hospitals with pharmacies in the U.S. remained fairly stable during the period of time covered by this inquiry. The number of these U.S. hospitals increased by approximately 360 between 1995 and 2007. In 2005, there were 6,641 hospitals with pharmacies in the U.S. The mean number of such hospitals during the period of time covered by this inquiry was 6,429. The number of hospitals decreased from the mid 1990s to the mid 2000s then the number of hospitals started climbing.

Pharmacies (Pharm) There was an average of 77,667 pharmacies in the U.S. between 1994 and 2009. During the early part of this period the number of pharmacies fluctuated and there was a downward trend in the number of pharmacies. In the years following 2001, there was a remarkable upward trend in the number of pharmacies and by 2009 there were 84,813 pharmacies, an increase of 16% between 2001 (when the number of pharmacies was the lowest for the period) and 2009.

Prescription Filled (Rx) The number of prescriptions filled has consistently increased every year from 1996 through 2009. There were over 2.2 billion prescriptions filled in 1996 with this number increasing to over 3.6 billion by 2009. The mean number of prescriptions filled for the timeframe for this inquiry was 2.9 billion. It is likely that the volume of prescriptions written and dispensed will continue to rise as a result of many factors. Perhaps the most noteworthy of these factors is the rapid growth of the 65 and over segment of the population and a rapid and significant increase in the proportion of the population that is insured.

Physicians (Dr) Between 1994 and 2008 the number of physicians grew by 27%. The mean number of physicians during this period was 757,028. There was a consistent upward trend in the number of physicians during the period of time for this inquiry. The number of physicians reached a peak of 848,933 in 2008. The size of the physician population is marked by such demographic trends as the influx of international medical graduates and fluctuations in the number of allopathic and osteopathic medical schools.

Median Household Income (MHI) The median household income fluctuated between 1994 and 2009 reaching a high of $52,138 in 2008 and a low of $46,399 in 1994. The mean median household income for this 16--year time period was $50,153. There was a remarkable decline in the median household income during the last two years of the 16 year period covered by this inquiry.

Number of hospitals beds per 100,000 population (HospC) The number of hospital beds per 100,000 population decreased consistently over the 13 year time period beginning in 1995 and ending in 2007. During this period, there was a mean of 377 hospital beds per 100,000 population. The maximum number of hospitals beds per 100,000 population during this 13 year period peaked at 447 in 1995.

The number of hospital beds per 100,000 population is expected to be marked by a perceptible decrease in coming years due to a growing trend of shifting inpatient care to outpatient care.

Number of pharmacies per 100,000 population (PharmC) The number of pharmacies per 100,000 population remained stable over the period 1995 to 2008, with a mean of 30 pharmacies per 100,000 population. The number of pharmacies per 100,000 population reached a peak of 33 in 2006 and a low of 28 in 1995.

Office Based Physicians per 100,000 population (OBDR) The number of office based physicians per 100,000 population grew every year between 1995 and 2008. During this period there was a mean of 178 office based physicians per 100,000 population, with a minimum of 157 and a maximum of 180.

Employer Volume (EmpV) During the period of time covered by this inquiry there was a mean of 7.1 million employers in the U.S. The number of employers reached a maximum of 7.7 in 2007. There was a downturn in the U.S. economy during the latter part of the decade ending in 2009. Consistent with a decline in the economy there was a decrease in the number of employers during the last two years of the period of time covered by this inquiry.

Employer Size (EmpS1, EmpS2) For the purposes of this inquiry, employers size consists of two categories: employers having 19 or fewer employees (EmpS1) and those with 20 or more (EmpS2). There was a mean of 4.6 million employers with 19 or fewer employees during the period for this inquiry. The corresponding mean for employers with 20 or more employees was 2.5. Employers with 20 or more employees reached a maximum of 2.8 million in 2004. The maximum number of employers with 19 or fewer employees was 5.4 in 2007.

Insured Population (Ins) The number of U.S. citizens with health insurance grew consistently during the 16 year period for this inquiry. In fact, the number of insured increased in each year of the period with a total increase of 13% between 1994 and 2009. On average, there were 240 million Americans with health insurance for the period 1994 to 2009. The insured population grew from 222 million in 1994 to 253 million by 2009. The insured population accounted for 82% of the entire U.S. population in 2009.

Model Specification Interpretation

The model for this inquiry was presented in chapter 3. Within the context of the population ecology theoretical framework are munificence (M) and concentration (C) which are the overarching constructs posited to have an appreciable impact on the pharmacist supply. The indicators of these two dimensions are the independent variables that were discussed in chapter 3 and summarized in the above section. While munificence and concentration vary with time and cannot be observed directly, they are useful for identifying and characterizing environmental factors and interactions among them that affect the pharmacist supply. The pharmacist supply is represented by the following model.

$$P_{jk} = ß_0 + ß_{1j} * year_j + ß_{2j} + \alpha_k + E_{jk}$$

P_{jk} represents the pharmacist supply as it interacts with the environment. $ß_0$ is the intercept for the model and it is an estimate of the baseline of the pharmacist supply. The parameter $ß_{1j}$ represents the relationship between year and the pharmacist supply. $ß_{2j}$ represents the relationship between the pharmacist supply and the independent variable being measured. The pharmacist supply in this inquiry, as previously stated it is the sum of the total number of pharmacists in each state and the District of Columbia with instate addresses. It is believed that there may be forces at work in each state that could affect the pharmacist supply when the data from the states are combined. It is believed that there is not sufficient data to account for these forces in the states. α_k represents random effects in the model that may be the result of these forces. E represents the error term within the model.

A mixed effects statistical model was used in this inquiry of the pharmacist supply. The inclusion of a random effects term in the model makes it more robust and more methodologically sound. It is believed that more of the variation in the pharmacist supply can be accounted for using a statistical model with both fixed and random effects than with a fixed effects model alone. Moreover, the inclusion of a random effects term is consistent with the LV model discussed previously in the literature and in this inquiry.

It follows logically that if year is the covariate in the repeated measures regression that is the principal statistical tool used in this inquiry, a random effects term is needed to account for the fact that the total number of pharmacists from year to year are not orthogonal. As a result, without the random effects term, our model may yield tenuous results that may confound our findings in this inquiry.

It is assumed that the random effects follow a distribution across years and they inform the model that the observations for the pharmacist supply are correlated. Consequently, a mixed effects statistical model allows the ability to draw more tenable conclusions using repeated measures regression to explain the variation in the total number of pharmacists from year to year during the period covered by this inquiry.

Assumption Testing

Pharmacist supply was found to have a non-normal distribution over the 16 year timeframe. A basic requirement of linear regression is that the dependent variable is normally distributed. In order to overcome this problem, a transformation of the dependent variable was completed using its natural logarithm.

This is a common and frequently used statistical manipulation to achieve a normally distributed dependent variable for the purposes of linear regression (Tabachnick & Fidell, 2001).

Hypothesis Testing

Munificence.

M refers to the level of resource supply within the environment. In this inquiry hypotheses H1-H7 are tested to determine whether or not M is a significant environmental factor impacting the pharmacist supply.

H1 There is a positive, linear relationship between a change in the size of the population and a change in the pharmacist supply over time.

Equation1: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2 \mathbf{Pop} + \alpha_k + E_{jk}$

It is hypothesized that the size of the population is positively, linearly associated with the pharmacist supply over time. This hypothesis was tested using repeated measures regression. Population was found to have a significant, statistically discernible impact on the number of licensed pharmacists with instate addresses during the 16--year period covered by this inquiry (p=.04). The results of the repeated measures regression analysis are summarized in Tables 7 and 8.

Table 7. Summary of the Fixed Effect of Population on Pharmacist Supply, 1994-2009

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	15	663	68.76	<.0001
Pop	1	709	4.15	0.042

Table 8. Parameter Estimates for Population, 1994-2009

	Year	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept		8.1026	0.1497	49.8	54.14	<.0001
Year	1994	-0.3293	0.01481	670	-22.24	<.0001
Year	1995	-0.3069	0.01473	669	-20.83	<.0001
Year	1996	-0.2611	0.01458	668	-17.91	<.0001
Year	1997	-0.2505	0.0145	668	-17.27	<.0001
Year	1998	-0.2542	0.01443	667	-17.62	<.0001
Year	1999	-0.2163	0.01436	667	-15.07	<.0001
Year	2000	-0.1856	0.01423	665	-13.04	<.0001
Year	2001	-0.167	0.01401	664	-11.92	<.0001
Year	2002	-0.1474	0.01395	664	-10.57	<.0001
Year	2003	-0.1349	0.01383	663	-9.75	<.0001
Year	2004	-0.13	0.01371	663	-9.48	<.0001
Year	2005	-0.1201	0.01368	663	-8.78	<.0001
Year	2006	-0.099	0.01372	662	-7.22	<.0001
Year	2007	-0.0597	0.0137	662	-4.35	<.0001
Year	2008	-0.0265	0.01383	662	-1.91	0.0561
Year	2009	0	.	.	.	.
Pop		1.06E-08	0	0	.	.

The test results for H1 lead to acceptance and to conclude that the size of the resident population is a significant environmental factor impacting the pharmacist supply. This finding is consistent with other findings in the literature. Walton et al. (2004) corroborates these results. In their inquiry it was found that population was a strong retro prospective predictor of pharmacists. Year was found to be a significant covariate. Thus, the size of the population in one year is a significant predictor of the pharmacist supply in a subsequent year.

H2 There is a positive, linear relationship between a change in the size of the elderly population and a change in the pharmacist supply over time.

Equation2: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **Pop 65+** $+ \alpha_k + E_{jk}$

Persons 65 years of age and older use a disproportionate share of prescription medications because they are more likely to have one or more chronic conditions that are controlled and treated with prescription medications. In H2 it is hypothesized that the size of the elderly population would have a positive, significant impact on the pharmacist supply over time. The 65+ segment of the population was not found to have a statistically significant impact on the pharmacist supply over time (p=.06). The results of the repeated measures regression analysis for H2 are presented and summarized in Table 9.

Table 9. Summary of the Fixed Effect of the 65+ Population on Pharmacist Supply 1994-2009

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	15	664	95.56	<.0001
Pop65+	1	679	3.4	0.0657

The test results for H2 lead to rejection and to conclude that the size of the elderly population is not a significant environmental factor impacting the pharmacist supply. The census projections indicate that the elderly will make up at least 20% of the U.S. population by the year 2030, and the prediction is that the prescription drug use will continue to climb (Manasse & Speedie, 2007).

In addition to this growth in the elderly population are all indicators of a rapid and persistent rise in demand for pharmacists (Gershon, Cultice, & Knapp, 2000). While these two studies display the elderly population having a strong impact on the pharmacist supply, the empirical evidence in this study oppose this premise. The parameter estimates for the 65+ population based upon the repeated measures regression analysis for H2 are presented in Table 10.

Table 10. Parameter Estimates for the 65+ Population 1994-2009

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.1372	0.1511	48.9	<.0001
Year	1994	-0.3343	0.01421	665	<.0001
Year	1995	-0.3116	0.01418	665	<.0001
Year	1996	-0.267	0.01396	665	<.0001
Year	1997	-0.2563	0.01393	664	<.0001
Year	1998	-0.2593	0.01394	664	<.0001
Year	1999	-0.2211	0.01393	664	<.0001
Year	2000	-0.1876	0.01408	665	<.0001
Year	2001	-0.1686	0.01389	665	<.0001
Year	2002	-0.1485	0.01388	665	<.0001
Year	2003	-0.1357	0.01378	665	<.0001
Year	2004	-0.1305	0.01368	664	<.0001
Year	2005	-0.1204	0.01366	664	<.0001
Year	2006	-0.099	0.0137	664	<.0001
Year	2007	-0.0597	0.01369	664	<.0001
Year	2008	-0.0267	0.01381	664	0.0541
Year	2009	0	.	.	.
Pop65+		3.88E-08	0	0	.

H3 There is a positive, linear relationship between the number of hospitals with pharmacies and the pharmacist supply over time.

Equation 3: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2 \mathbf{Hosp} + \alpha_k + E_{jk}$

Hospitals are a primary location in which pharmacists utilize their unique skill set. In this setting, pharmacists often work on teams alongside physicians and nurses to provide optimal therapies leading to desirable patient outcomes. In light of this fact, it seems plausible that the pharmacist supply would be positively impacted by growth in the number of hospitals with pharmacies as more pharmacists would be required to staff these hospitals. The results of a repeated measures regression analysis to test H3 revealed that there is a positive, linear association between the number of hospitals with pharmacies and the pharmacist supply (p=.006), controlling for year. The results of the analysis are presented in Tables 11 and 12.

Table 11. Summary of the Fixed Effect of Hospitals with Pharmacies on Pharmacist Supply 1995-2007.

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	8	360	64.69	<.0001
Hosp	1	368	7.51	0.0064

Table 12. Parameter Estimates for Hospitals with Pharmacies 1995-2007 Results.

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.0901	0.1472	48.8	<.0001
Year	1995	-0.2541	0.01243	360	<.0001
Year	2000	-0.1294	0.01244	360	<.0001
Year	2001	-0.1102	0.01229	360	<.0001
Year	2002	-0.09	0.01229	360	<.0001
Year	2003	-0.0755	0.01222	360	<.0001
Year	2004	-0.0706	0.01212	360	<.0001
Year	2005	-0.0628	0.01209	360	<.0001
Year	2006	-0.0402	0.01215	360	0.001
Year	2007	0	.	.	.
Hosp		0.00043	0.00016	368	0.0064

The test results for H3 lead to acceptance and to conclude that the number of hospitals with pharmacies is a significant environmental factor impacting the pharmacist supply. The DHHS (2000) supported the premise that hospitals need for pharmacists are due to an ever expanding role to care for a growth in the number of complex diseases and conditions treatable by medication. The sharp increase in the utilization of prescription drugs, among additional factors, has been a driving force in the need for pharmacists in the hospital setting (Wisconsin Hospital Association, 2006).

The findings in this inquiry are consistent with these assessments made by DHHS and the Wisconsin Hospital Association. Year was found to be a significant covariate. Thus, the number of hospitals in one year is a significant predictor of the pharmacist supply in a subsequent year.

H4 There is a positive, linear relationship between the number of pharmacies and the pharmacist supply over time.

Equation 4: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2$ **PharmF** $+ \alpha_k + E_{jk}$

Although the number of hospitals with pharmacies employing pharmacists increased between 1995 and 2007, the primary venue in which pharmacists practice continues to be retail pharmacies, super market pharmacies, and chain drugstores. Ostensibly, it would appear that the number of community-based pharmacies might have a significant impact on the pharmacist supply over time. Hypothesis 4 was tested with this in mind. It was hypothesized that the number of pharmacies is positively, linearly associated with the pharmacist supply over time. An analysis to test this hypothesis revealed that, for the period 1995-2007 the number of pharmacies does not have a statistically discernible impact (p=.13) on the pharmacist supply from year to year. The results of the analysis are presented in Table 13.

Table 13. Summary of the Fixed Effect of Number of Pharmacies on Pharmacist Supply, 1995-2007

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	14	619	89.83	<.0001
# of Pharmacies	1	621	2.23	0.1362

The test results for H4 lead to the rejection and to conclude that the number of pharmacies is not a significant environmental factor impacting the pharmacist supply. The need for pharmacists has been a constant area of concern as pharmacies have cut their hours of service and in some instances retired pharmacists reentering the work force (Manasse & Speedie 2007). The need for pharmacists may be greater in certain community/retail settings than in hospital or institutional settings (Mott et al., 2006). The results in this inquiry are in direct contrast with the literature. The parameter estimates for the number of pharmacies based upon the repeated measures regression analysis for H4 are presented in Table 14. It bears watching how the number of pharmacies changes over time as an increasing number of pharmacists enter the healthcare arena.

Table 14. Parameter Estimates for Number of Pharmacies, 1995-2007

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.1566	0.1525	48.5	<.0001
Year	1995	-0.3139	0.01359	619	<.0001
Year	1996	-0.2681	0.01359	619	<.0001
Year	1997	-0.2572	0.01346	619	<.0001
Year	1998	-0.2605	0.01345	619	<.0001
Year	1999	-0.2219	0.01347	619	<.0001
Year	2000	-0.1897	0.01353	619	<.0001
Year	2001	-0.1701	0.01344	619	<.0001
Year	2002	-0.1492	0.01342	619	<.0001
Year	2003	-0.1375	0.01327	619	<.0001
Year	2004	-0.1324	0.01318	619	<.0001
Year	2005	-0.1228	0.01317	619	<.0001
Year	2006	-0.1009	0.01323	619	<.0001
Year	2007	-0.061	0.01323	619	<.0001
Year	2008	-0.02728	0.01337	619	0.0418
Year	2009	0	.	.	.
# of pharmacies		6.72E-06	4.51E-06	621	0.1362

H5 There is a positive, linear relationship between the number of prescriptions filled and the pharmacist supply over time

Equation 5: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2 \mathbf{Rx} + \alpha_k + E_{jk}$

Hypothesis 5 addresses the number of prescriptions filled over time and its impact on the pharmacist supply. The number of prescriptions filled is another indicator of M.

It is hypothesized that there is a positive, linear relationship between the number of prescriptions filled and the pharmacist supply over time. This hypothesis was tested using Equation 5 above. Results from a repeated measures regression reveal that the number of prescriptions filled does not have a statistically discernible impact (p=.12) on the pharmacist supply over time. Based on this finding H5 was rejected. Results of the test of H5 are presented in Table 15.

Table 15. Summary of Fixed Effects of Prescriptions Filled on Pharmacist Supply, 1996-2009

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	13	579	50.87	<.0001
Rx	1	589	2.34	0.1263

The test results for H5 lead to rejection and to conclude that the number of prescriptions is not a significant environmental factor impacting the pharmacist supply. This outcome is rather surprising considering the current volume of prescriptions being filled. Based upon current trends and annual growth rates, it is estimated that approximately 7.2 billion prescriptions will be written to be filled in 2020, with an estimated 80,000 to 100,000 additional FTE pharmacists needed to meet such a great prescription demand (Pal, 2002). According to the Kaiser Family

Foundation (2011), this projection appears to be probable in light of the fact that approximately 4 billion prescriptions were dispensed in 2010.

At this juncture, the prescription volume appears not to be a good predictor of the pharmacist supply, possibly due to the current pharmacist supply's ability to handle the workload. Nevertheless, this trend seems to be in jeopardy based upon projections of prescriptions to be filled and may cause a serious ramification for the future. The parameter estimate results for the number of prescriptions filled H5 are presented in Table 16.

Table 16. Parameter Estimate for Number of Prescriptions filled, 1996-2009

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.1976	0.1574	49.1	<.0001
Year	1996	-0.2817	0.01508	581	<.0001
Year	1997	-0.2699	0.01487	581	<.0001
Year	1998	-0.2719	0.01451	581	<.0001
Year	1999	-0.2316	0.01398	580	<.0001
Year	2000	-0.198	0.01374	579	<.0001
Year	2001	-0.1779	0.0134	579	<.0001
Year	2002	-0.1569	0.01329	579	<.0001
Year	2003	-0.1432	0.01318	579	<.0001
Year	2004	-0.1374	0.01307	579	<.0001
Year	2005	-0.1263	0.01298	579	<.0001
Year	2006	-0.1036	0.01291	579	<.0001
Year	2007	-0.06223	0.0128	578	<.0001
Year	2008	-0.02818	0.01291	578	0.0295
Year	2009	0	.	.	.
Rx		-4.00E-10	0	0	.

H6 There is a positive, linear relationship between the size of the physician population and the pharmacist supply over time.

Equation 6: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2 \mathbf{Dr} + \alpha_k + E_{jk}$

Physicians are key players in the U.S. healthcare system. They diagnose and treat diseases. Among the treatment options used by physicians are pharmaceutical interventions that require prescriptions. It seems logical that the size of the physician population might be related to the pharmacist supply.

In previous studies it has been shown that there is a consistent increase in both the physician and pharmacist workforce populations in recent years (Shih, 1999; DHHS, 2006; DHHS, 2008). In light of previous studies, it is hypothesized that there is a positive, linear relationship between the number of physicians and the pharmacist supply.

Hypothesis H6 was tested using a repeated measures regression analysis. Results indicated that, controlling for year, there is no statistically significant relationship (p=.48) between the physician population and the pharmacist supply for the 16 year period covered by this inquiry. A summary of the tests of H6 is found in Table 17.

Table 17. Summary of the Fixed Effects of Number of Physicians on Pharmacist Supply, 1994- 2008

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	14	623	51.46	<.0001
DR	1	656	0.49	0.4832

The relationship between physicians and pharmacists seems to be one of possible commensalism. Commensalism refers to a relationship where one subject or organism benefits but the other is neutral (there is no harm or benefit). This will continue to be a relationship of interest as the number of physicians continues to increase. The yearly results of the repeated measures regression analysis for H6 are presented in Table 18.

Table 18. Parameter Estimates for Number of Physicians, 1994-2008

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.161	0.1582	49.7	<.0001
Year	1994	-0.3173	0.01578	631	<.0001
Year	1995	-0.2936	0.01532	629	<.0001
Year	1996	-0.2469	0.01499	628	<.0001
Year	1997	-0.2352	0.0147	626	<.0001
Year	1998	-0.2379	0.01445	625	<.0001
Year	1999	-0.1991	0.01431	624	<.0001
Year	2000	-0.1664	0.01425	624	<.0001
Year	2001	-0.1471	0.014	623	<.0001
Year	2002	-0.1264	0.01389	623	<.0001
Year	2003	-0.1125	0.01371	622	<.0001
Year	2004	-0.1069	0.0136	622	<.0001
Year	2005	-0.09621	0.01357	622	<.0001
Year	2006	-0.07419	0.01361	622	<.0001
Year	2007	-0.03395	0.01359	621	0.0128
Year	2008	0	.	.	.
DR		-1.16E-06	1.65E-06	656	0.4832

H7 There is a positive, linear relationship between the median household income and the pharmacist supply over time.

Equation 7: $P_{jk} = ß_0 + ß_{1j} * year_j + ß_2 \mathbf{MHI} + \alpha_k + E_{jk}$

In H7 it was hypothesized that there is a positive, linear relationship between median household income and pharmacist supply over time.

Median household income is the final indicator of M used in this inquiry. Hypothesis H7 was tested utilizing a repeated measures regression and found that median household income did not have a statistically discernible impact (p=.89) on pharmacist supply for the time period covered by this inquiry. These results are presented in Table 19.

Table 19. Summary of Fixed Effects of Median Household Income on Pharmacist Supply, 1994-2009

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	15	665	90.88	<.0001
MHI	1	668	0.02	0.8976

Hypothesis 7 was rejected when it was tested to determine if the median household income supports the premise that income level affected pharmacist supply. The yearly results of the repeated measures regression analysis for H7 are presented in Table 20 this is illustrated by the parameter estimates. Previous research provided empirical evidence that a community's wealth does impact their ability to afford healthcare.

To support this premise there are findings that have determined that people with higher levels of income tend to purchase more healthcare, all other factors being equal (Sing, Miller, & Banthin, 2008). This study provides some indication that income can affect one's ability to attain healthcare which affects the supply needed to meet a perceived demand for certain services and supplies.

So, while median household income was not a predictor of the pharmacist supply, however it seems there is the ability for it to have an indirect impact on the pharmacist supply.

The median household income was found not to be statistically significant; however it may be possible that health insurance safeguards compensate for income for some families.

Table 20. Parameter Estimates for Median Household Income, 1994-2009

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.175	0.1622	60.2	<.0001
Year	1994	-0.3399	0.01442	665	<.0001
Year	1995	-0.3168	0.01422	665	<.0001
Year	1996	-0.2705	0.01402	665	<.0001
Year	1997	-0.2592	0.01391	665	<.0001
Year	1998	-0.2622	0.01389	665	<.0001
Year	1999	-0.2237	0.01401	665	<.0001
Year	2000	-0.191	0.01412	665	<.0001
Year	2001	-0.1719	0.01386	665	<.0001
Year	2002	-0.1517	0.01379	665	<.0001
Year	2003	-0.1386	0.01371	665	<.0001
Year	2004	-0.1331	0.01363	665	<.0001
Year	2005	-0.1226	0.01363	665	<.0001
Year	2006	-0.1007	0.01376	665	<.0001
Year	2007	-0.06076	0.01387	665	<.0001
Year	2008	-0.0271	0.01383	665	0.0505
Year	2009	0	.	.	.
MHI		-1.34E-07	0	0	.

Pharmacist Supply Munificence Summary

The goal of utilizing munificence in this inquiry was to measure the environmental resources on the pharmacist supply. This will help to facilitate strategic decisions on the pharmacist supply. The greater the level of munificence, the more opportunities the environment provides which tremendously increases organization's ability to survive and flourish.

It has been noted through multiple studies that there is a plethora of factors that has the potential to influence the pharmacist supply. The Walton et al. (2004) study determined that population and the number of community pharmacy prescriptions were very accurate predictors of the number of pharmacists.

There have been studies such as Reissman (2004) that look at the elderly and insured population with certain instances in the study alluding to its impact on the pharmacist supply. In the majority of the studies reviewed the pharmacists are directly tested against environmental factors such as facilities, prescriptions filled, or the population. While this is important, it is imperative to expand the scope of research and examine the pharmacist supply against environmental factors such as the number of physicians and median household Income.

The ability for physicians to influence the pharmacist supply is not relegated to just prescriptions written, there are other aspects such as consulting calls, and placement of both on multidisciplinary teams. The ability to afford one's healthcare is also vital to this research in that it has not been addressed whether income levels are predictors of the pharmacist supply. The evidence in this inquiry will help to determine if the number of prescriptions affects the pharmacist supply. This inquiry will not only address previous environmental factors but additional ones as well which will provide empirical evidence for future investigational studies.

Concentration

Concentration describes the level to which resources are evenly distributed. It will be measured by H8-H12.

H8 There is a positive, linear relationship between hospital beds per 100,000 population and the pharmacist supply over time.

Equation 8: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2\,HospC + \alpha_k + E_{jk}$

Hospitals provide treatment and care at varying levels, with the level of specialization having an association with the number of occupied beds and length of stay. The provision of tertiary care leads to an increase in occupied beds in a facility. This, in turn, can amplify the demand for pharmacists who are integral in drug therapy for patients.

In H8 it was hypothesized that the number of hospital beds per 100,000 population would have a positive, significant impact on the pharmacist supply over time. The analysis conducted determined that the number of hospital beds per 100,000 population did not have a statistically tangible impact on the pharmacist supply for the period of time in this study (p=.09). Tables 21 and 22 presented below display the results for H8.

Table 21. Summary of Fixed Effects of Hospital Beds Per 100,000 Population on Pharmacist Supply, 1995-2007

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	8	362	21.19	<.0001
Beds	1	377	2.86	0.0919

Table 22. Parameter Estimates for Hospital Beds Per 100,000 Population, 1995-2007

Solution for Fixed Effects						
Effect	Year	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept		8.0145	0.171	74.8	46.87	<.0001
Year	1995	-0.2893	0.02322	372	-12.46	<.0001
Year	2000	-0.1429	0.01401	364	-10.2	<.0001
Year	2001	-0.1236	0.01376	364	-8.98	<.0001
Year	2002	-0.1001	0.01301	362	-7.69	<.0001
Year	2003	-0.08353	0.01256	361	-6.65	<.0001
Year	2004	-0.07624	0.01226	360	-6.22	<.0001
Year	2005	-0.06405	0.01214	360	-5.27	<.0001
Year	2006	-0.04063	0.01217	360	-3.34	0.0009
Year	2007	0	.	.	.	.
Beds		0.000385	0.000228	377	1.69	0.0919

The test results for H8 lead to rejection and to conclude that the number of hospital beds per 100,000 population is not a significant environmental factor impacting the pharmacist supply. Hospitals with tertiary care services are subject to longer occupied beds days compared to facilities with less specialized services.

This, in turn, increases the demand for pharmacists whose role has increased with emphasis on collaborative care and patient interaction (Kaboli, Hoth McClimon, & Schnipper, 2006). The number of pharmacists involved in monitoring patients increased to 84% of hospitals in the 2008 survey compared to 75% in 2000 with larger bedded hospitals employing a greater number of pharmacists (Pederson, Schneider & Sheckelhoff, 2009). While these two studies exhibit hospital beds having a strong impact on the pharmacist supply, the empirical evidence in this study oppose this premise.

H9 There is a positive linear relationship between the number of pharmacies per 100,000 people and the pharmacist supply over time.

Equation 9: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2 \mathbf{PharmFC} + \alpha_k + E_{jk}$

As noted earlier there are approximately 55,400 community pharmacies in the U.S., More than 50 percent are members of chains and the remainders are independently owned. Chain pharmacies fall into the following categories: traditional chains (e.g., CVS), mass merchandisers (e.g., Walmart), and supermarket pharmacies (e.g., Safeway) (Christensen & Farris, 2006). Hypothesis 9 in the concentration dimension measures the number of pharmacies per 100,000. population and the pharmacist supply over time. It is hypothesized that the number of pharmacies per 100,000 population is positively linearly associated with the pharmacist supply over time. The analysis conducted determined that the number of pharmacies per 100,000 population did not have a statistically significant impact on the pharmacist supply for the period of time in this study (p=73). Due to the statistical results, H9 was rejected as a predictor of pharmacist supply. Chain pharmacies operate approximately 39,000 pharmacies and fill nearly 2.6 billion prescriptions annually, which account for more than 72% of annual prescriptions filled in the United States (NACDS, 2011). Tables 23 and 24 illustrate the results for H9.

Table 23. Summary of Fixed Effects of Pharmacies Per 100,000 Population on Pharmacist Supply, 1994-2008.

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	14	619	95.58	<.0001
Pharmacies per 100,000 population	1	619	0.11	0.7387

Table 24. Parameter Estimates for Pharmacies Per 100,000 Population, 1994-2008

Solution for Fixed Effects						
Effect	Year	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept		8.1675	0.1535	48.4	53.21	<.0001
Year	1995	-0.3163	0.01351	619	-23.42	<.0001
Year	1996	-0.2708	0.0135	619	-20.07	<.0001
Year	1997	-0.2589	0.01342	619	-19.29	<.0001
Year	1998	-0.2621	0.01342	619	-19.53	<.0001
Year	1999	-0.2238	0.01342	619	-16.67	<.0001
Year	2000	-0.1913	0.01351	619	-14.16	<.0001
Year	2001	-0.1725	0.0136	619	-12.68	<.0001
Year	2002	-0.1506	0.01341	619	-11.23	<.0001
Year	2003	-0.1385	0.01327	619	-10.44	<.0001
Year	2004	-0.133	0.01319	619	-10.09	<.0001
Year	2005	-0.1227	0.01319	619	-9.3	<.0001
Year	2006	-0.1009	0.01325	619	-7.62	<.0001
Year	2007	-0.0611	0.01325	619	-4.61	<.0001
Year	2008	-0.0276	0.01338	619	-2.06	0.0399
Year	2009	0	.	.	.	.
Pharmacies per 100,000 population		2.1E-05	6.3E-05	619	0.33	0.7387

The majority of currently employed pharmacists work for community pharmacies. While these statistics from the literature point to the magnitude of prescriptions dispensed by chain pharmacies, it does not account for the over-the-counter consumers asking questions and needing behind the counter nonprescription medication. While there are studies in the literature that lend support to pharmacies as a predictor, the empirical evidence in this study opposes this assertion.

H10 There is a positive linear relationship between the number of office based physicians per 100,000 population and the pharmacist supply over time.

Equation 10: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2\, \mathbf{PharmFC} + \alpha_k + E_{jk}$

Physicians are primarily responsible for almost all of the prescriptions that are written in the United States. Hypothesis 10 is focused on office-based physicians per 100,000 population, a variable within the concentration dimension of the population ecology theory. The volume of scripts being written can impact the workload of pharmacists. In an outpatient or office-based setting, physicians write a significant amount of prescriptions, thereby leading to a specified need for pharmacists to meet the demands. It is hypothesized that the number of office-based physicians per 100,000 population has a positive linear association with the pharmacist supply over time. The results of the analysis determined that when adjusting for year the number of office based physicians per 100,000 population does not have an effect on the pharmacist supply ($p=.51$). The results are displayed in Tables 25 and 26.

Table 25. Summary of Fixed Effects of Office Based Physicians Per 100,000 Population on Pharmacist Supply, 1995-2008

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	9	405	33.36	<.0001
OBDR per 100,000 population	1	419	0.42	0.5184

Table 26. Parameter Estimates for Office Based Physicians Per 100,000 Population, 1995-2008

Solution for Fixed Effects						
Effect	Year	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept		8.2666	0.1989	132	41.57	<.0001
Year	1995	-0.301	0.02134	414	-14.11	<.0001
Year	2000	-0.171	0.01449	408	-11.8	<.0001
Year	2001	-0.1487	0.01256	405	-11.83	<.0001
Year	2002	-0.1286	0.01262	405	-10.19	<.0001
Year	2003	-0.1118	0.01227	404	-9.11	<.0001
Year	2004	-0.1058	0.01226	404	-8.63	<.0001
Year	2005	-0.0929	0.01314	406	-7.07	<.0001
Year	2006	-0.0716	0.01261	405	-5.67	<.0001
Year	2007	-0.032	0.01251	405	-2.56	0.011
Year	2008	0	.	.	.	.
OBDR per 100,000 population		-0.0005	0.00074	419	-0.65	0.5184

The empirical evidence provided by the analysis lead to the rejection of H10. According to a study by Cherry et al. (2007), physicians wrote 2 billion prescriptions during office visits in 2005. To keep this in perspective, there were approximately 1.5 billion physician office visits in 2008, with approximately 20% of those visits resulting in patients leaving with at least one prescription (Medical Expenditure Panel Survey, 2010).

These two studies provide support to the argument that office based physicians can be a strong predictor on the pharmacist supply through the volume of prescriptions physicians generate. Although the empirical evidence in this inquiry was rejected, there may to be a potential commensalism relationship between office-based physicians and the pharmacist supply or an indirect influence.

H11a There is a positive linear relationship between the number of employers and the pharmacist supply over time.

H11b1 There is a positive linear relationship between employer size (19 or less employees) and the pharmacist supply over time.

H11b2 There is a positive linear relationship between employer size (20 or more employees) and the pharmacist supply over time.

Equation 11a: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2 \textbf{EmpV} + \alpha_k + E_{jk}$
Equation 11b1: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2 \textbf{EmpS1} + \alpha_k + E_{jk}$,
Equation 11b2: $P_{jk} = ß_0 + ß_{1j}*year_j + ß_2 \textbf{EmpS2} + \alpha_k + E_{jk}$,

Employers play a key role as purchasers and administrators of health insurance for the working-age population in the United States, with the majority of Americans obtaining their health insurance through an employer. The following two hypotheses address the employers and influence on the pharmacist supply. Hypotheses 11a, 11b1 and 11b2 in the concentration dimension is characterized by the total number of employers and the size of the employer (19 employees or less, 20 or more employees) respectively. Specifically, it is hypothesized in 11a that the number of employers is positively linearly associated with the pharmacist supply over time.

In H11a the total number of employers was not found to be significant predictor of the pharmacist supply (p=.85), therefore H11a was rejected. The results of the statistical analysis on H11a are illustrated in Tables 27 and 28.

Table 27. Summary of the Fixed Effect of Total Number of Employers on Pharmacist Supply, 1994-2008

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	14	621	61.83	<.0001
EmpV	1	668	0.03	0.8534

Table 28. Parameter Estimates for Total Number of Employers, 1994-2008

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.1343	0.1572	49.9	<.0001
Year	1994	-0.311	0.0148	628	<.0001
Year	1995	-0.2882	0.01465	627	<.0001
Year	1996	-0.242	0.01441	625	<.0001
Year	1997	-0.231	0.01422	624	<.0001
Year	1998	-0.2342	0.01417	623	<.0001
Year	1999	-0.1959	0.01411	623	<.0001
Year	2000	-0.1636	0.01411	622	<.0001
Year	2001	-0.1446	0.01393	622	<.0001
Year	2002	-0.1244	0.01386	621	<.0001
Year	2003	-0.111	0.01375	621	<.0001
Year	2004	-0.1057	0.0136	620	<.0001
Year	2005	-0.09531	0.01356	620	<.0001
Year	2006	-0.07364	0.01361	620	<.0001
Year	2007	-0.03389	0.01362	620	0.0131
Year	2008	0	.	.	.
EmpV		4.41E-08	0	0	.

While the total number of employers was not significant, the measurement of employers with varying employee sizes yielded mixed results.

In H11b1 and H11b2 it is hypothesized that the size of the employers is positively linearly associated with the pharmacist supply over time. Employers with 19 or less employees were found not to be significant (p=.35), and employers with 20 or more employees were found to be significant predictor when adjusting for year (p=.02). Tables 29-32 display the results of employer size.

Table 29. Summary of the Fixed Effect of Employers with 19 or Less Employees on Pharmacist Supply 1994-2008

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	14	623	69.09	<.0001
EmpS (19 or less employees)	1	640	0.84	0.3586

Table 30. Parameter Estimates for Employers with 19 or Less Employees, 1994-2008

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.16	0.157	49	<.0001
Year	1994	-0.3163	0.01463	624	<.0001
Year	1995	-0.2931	0.01456	624	<.0001
Year	1996	-0.2466	0.01441	624	<.0001
Year	1997	-0.2353	0.01436	624	<.0001
Year	1998	-0.2385	0.01433	624	<.0001
Year	1999	-0.2	0.01431	624	<.0001
Year	2000	-0.1675	0.01435	623	<.0001
Year	2001	-0.1484	0.01417	623	<.0001
Year	2002	-0.1282	0.01419	623	<.0001
Year	2003	-0.1147	0.01409	623	<.0001
Year	2004	-0.109	0.01394	623	<.0001
Year	2005	-0.0953	0.01352	622	<.0001
Year	2006	-0.0734	0.01359	622	<.0001
Year	2007	-0.03342	0.01359	622	0.0142
Year	2008	0	.	.	.
EmpS1 (19 or less employees)		-1.75E-07	0	0	.

Table 31. Summary of the Fixed Effect of Employers with 20 or More Employees on Pharmacist Supply 1994-2008

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	14	623	87.37	<.0001
EmpS2 (20 or more employees)	1	645	5.15	0.0236

Table 32. Parameter Estimates for Employers with 20 or More Employees, 1994-2008

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.0993	0.1492	48.6	<.0001
Year	1994	-0.3148	0.01392	622	<.0001
Year	1995	-0.2925	0.01395	622	<.0001
Year	1996	-0.2472	0.01392	622	<.0001
Year	1997	-0.238	0.01407	623	<.0001
Year	1998	-0.2416	0.0141	623	<.0001
Year	1999	-0.204	0.01418	623	<.0001
Year	2000	-0.1724	0.01435	623	<.0001
Year	2001	-0.1534	0.01418	624	<.0001
Year	2002	-0.1351	0.01444	624	<.0001
Year	2003	-0.1221	0.01442	625	<.0001
Year	2004	-0.118	0.01454	625	<.0001
Year	2005	-0.09254	0.01359	622	<.0001
Year	2006	-0.07216	0.01361	622	<.0001
Year	2007	-0.03358	0.01359	622	0.0137
Year	2008	0	.	.	.
EmpS2 (20 or more employees)		9.25E-07	0	0	.

The test results lead to the rejection of H11a, and 11b1, while accepting H11b2 and concluding that the number of employers is not a significant environmental factor impacting the pharmacist supply. However, the size of the employers can be a significant predictor in this regard. Findings in the literature have determined that large employers have significantly more employees who obtain healthcare coverage through their employer compared to smaller employers (SHADAC, 2011). Previous research provides credence to the empirical evidence found in H11b1 and H11b2, which helps one to deduce that employers wield a considerable amount of purchasing power in the healthcare arena, and consequently, may substantially impact the pharmacist demand and supply. The increase in the number of large employers affects the supply, by having the potential to offer more types of drug coverage which has the propensity to increase medication demand, while the increase in the number of small employers does not provide the same influence.

H12 There is a positive linear relationship between the number of insured and pharmacist supply over time.

Equation 12: $P_{jk} = ß_0 + ß_{1j}{*}year_j + ß_2\, \mathbf{Ins} + \alpha_k + E_{jk}$

The number of insured is significant in determining one's ability to obtain prescriptions which facilitates a pharmacist's workload and pharmacist demand. Hypothesis 12 focuses on the insured population and is the last variable in the concentration dimension being measured as part of the population ecology theory. In H12 it is hypothesized that the number of insured would have a positive, significant impact on the pharmacist supply over time. The number of insured was found to have a significant, statistically discernible impact on the number of licensed pharmacists with instate addresses during the 16--year period covered by this inquiry (p=.17). Table 33 provides the summary of repeated measures analysis on the number of insured. The parameter estimate results of the number of insured is presented in Table 34. The empirical evidence provided in this inquisition leads to acceptance of H12.

Table 33. Summary of the Fixed Effect of Number of Insured on Pharmacist Supply, 1994-2009

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	15	663	72.21	<.0001
Insured	1	711	5.66	0.0176

Table 34. Parameter Estimates for Number of Insured, 1994-2009

Solution for Fixed Effects					
Effect	Year	Estimate	Standard Error	DF	Pr > |t|
Intercept		8.0876	0.1483	49.9	<.0001
Year	1994	-0.3294	0.01457	668	<.0001
Year	1995	-0.307	0.01451	667	<.0001
Year	1996	-0.2612	0.01438	667	<.0001
Year	1997	-0.2502	0.01436	667	<.0001
Year	1998	-0.2539	0.01431	666	<.0001
Year	1999	-0.2184	0.01406	664	<.0001
Year	2000	-0.1867	0.01408	663	<.0001
Year	2001	-0.1677	0.0139	663	<.0001
Year	2002	-0.1479	0.01388	663	<.0001
Year	2003	-0.1353	0.01378	662	<.0001
Year	2004	-0.1307	0.01366	662	<.0001
Year	2005	-0.1209	0.01364	662	<.0001
Year	2006	-0.0995	0.0137	662	<.0001
Year	2007	-0.0608	0.01368	662	<.0001
Year	2008	-0.0276	0.01383	662	0.046
Year	2009	0	.	.	.
Insured		1.6E-05	6.62E-06	711	0.0176

The results of the analysis corroborates with previous research findings that the insured population has an impact on the pharmacist supply. One example of insurance coverage impact on the pharmacist supply is the implementation of Medicare Part D which helps make 14 to 30 million prescriptions available monthly at a cost savings to persons who may not have been able previously to afford their prescription drugs (Kostick, 2006).

In addition, the healthcare reform act would offer health insurance to an estimated 32 million previously uninsured people which would drive up the demand (Wechsler, 2010). These two studies in the literature add credence to the empirical evidence found in this investigation.

Pharmacist Supply Concentration Summary

Concentration describes the level to which resources are distributed. As with the goals specified in the munificence summary the primary interests in concentration revolve around applicability to the pharmacist supply. Organizations and entities that impact the distribution of resources include pharmacies, hospitals, physicians, and employers. The number of hospitals beds per 100,000 Population is of interest as it has been noted in several studies that more hospitals are making a concerted effort to increase the number of pharmacists they have to be part of their healthcare teams for monitoring patients (Pederson et al., 2009).

Measurement of chain pharmacies per 100,000 population had the potential to add considerable insight into the pharmacist supply. It was noted by NACDS (2011) that the chain pharmacies which are a part of their organization, operate approximately 39,000 pharmacies, and fill nearly 2.6 billion prescriptions annually, and account for more than 72% of annual prescriptions in the United States. The majority of currently employed pharmacists work for community pharmacies. While these statistics from the literature point to the magnitude of prescriptions dispensed by chain pharmacies, it does not account for the over-the-counter consumers asking questions and needing behind the counter nonprescription medication.

Measurement of the pharmacies per 100,000 population helps to directly examine the part of the pharmacy consumer and pharmacist workload not captured by the sheer number of prescriptions filled. Analysis of the office based physicians provides a more detailed interpretation of physicians on the pharmacist supply.

This is an important measurement since according to a study by Cherry et al. (2007), physicians wrote two billion prescriptions during office visits in 2005. The two hypotheses that were statistically significant in the concentration dimension were the size of employers (20 or more employees) and the number of insured. Nearly 60% of people with employer-sponsored health insurance coverage obtain it through large employers compared to slightly more than one in four persons with smaller employers (SHADAC, 2011). The evidence provided by this study corroborates the results in our inquiry. In addition another study was conducted on Medicare beneficiaries reported that drug coverage was associated with a 9.6% Increase in the probability of any prescription use (Huh, Rice, & Ettner, 2008).

The most prominent outcome of a larger percentage of persons having coverage for prescription drugs is likely to lead to an increased volume of prescriptions being written, which will increase demand for more pharmacists and pharmacy personnel (Vivian, 2010). These several studies demonstrate that employer size and the numbers of insured have an impact on the pharmacist supply which supports the empirical evidence in this study. The results from this inquiry will factor in the determination of the need to recruit pharmacists based upon the number of insured in your service area in conjunction with the type and size of employers that are in the service area.

Density.

Density explains the interactions between organizations in a community. It will be measured by H13.

H13 Is there a change in the pharmacist supply overtime.

The last hypothesis measured density in the pharmacist supply. Testing H13 was to determine if there is change in pharmacist population overtime. Some states had big spurts in growth from one year to the next year. In order to attain the correct results, the bonferroni correction, was utilized in order to account for the 14 differences that were tested. Based upon the bonferroni correction the significance level was calculated as .0035.

Overall, the pharmacist supply continued to rise at a consistent pace throughout the years, with their seeming to be no impact on its growth from the previous year supply levels. It is important to point out that while the pharmacist supply continued to grow steadily over the timeframe researched, there were only two years that were statistically significant 1995-1996 (p=.0008) and 2006-2007 (p=.0029). The results of the analysis are presented in Tables 35-38.

Table 35. Year Significance Test Results

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Year	15	666	104.1	1995 –1996, .0008 2006 – 2007, .0029

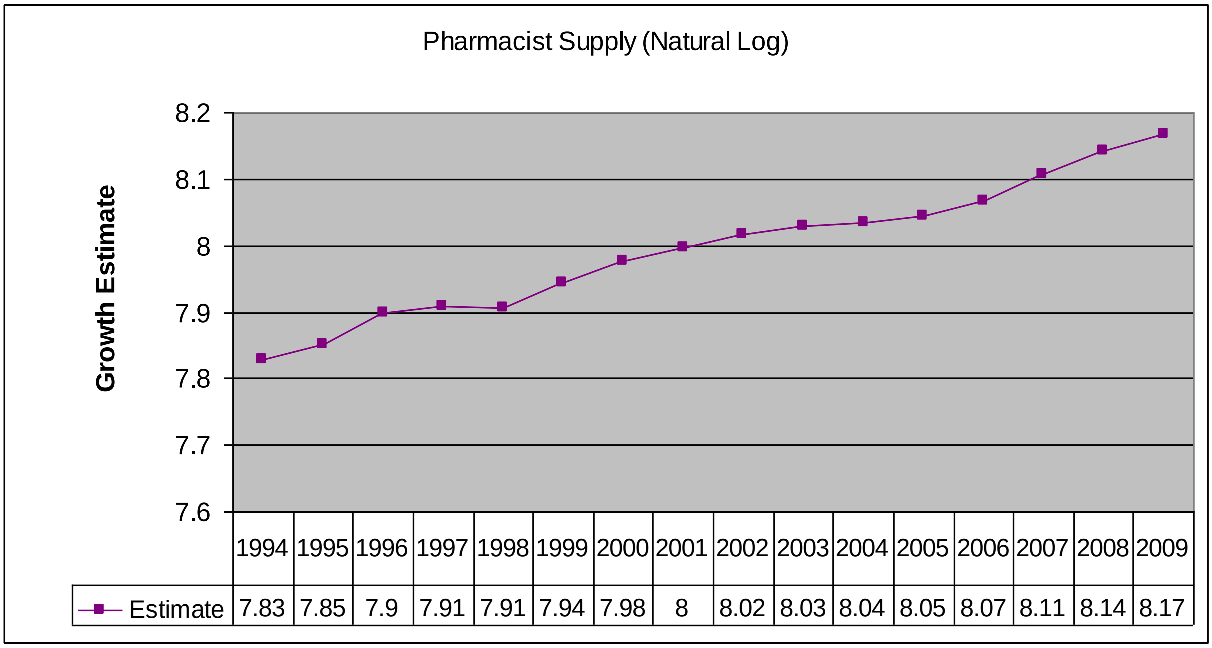
Table 36. Year Parameter Estimate Results

Least Squares Means								
Effect	Year	Estimate	Standard Error	DF	Pr > |t|	Alpha	Lower	Upper
Year	1994	7.8289	0.1535	48.4	<.0001	0.05	7.5203	8.1375
Year	1995	7.8518	0.1535	48.4	<.0001	0.05	7.5432	8.1604
Year	1996	7.8981	0.1535	48.4	<.0001	0.05	7.5895	8.2066
Year	1997	7.9092	0.1535	48.4	<.0001	0.05	7.6006	8.2178
Year	1998	7.906	0.1535	48.4	<.0001	0.05	7.5974	8.2146
Year	1999	7.9444	0.1535	48.4	<.0001	0.05	7.6358	8.253
Year	2000	7.977	0.1535	48.4	<.0001	0.05	7.6684	8.2856
Year	2001	7.9962	0.1535	48.4	<.0001	0.05	7.6876	8.3048
Year	2002	8.0165	0.1535	48.4	<.0001	0.05	7.7079	8.3251
Year	2003	8.0296	0.1535	48.4	<.0001	0.05	7.721	8.3382
Year	2004	8.0351	0.1535	48.4	<.0001	0.05	7.7266	8.3437
Year	2005	8.0456	0.1535	48.4	<.0001	0.05	7.7371	8.3542
Year	2006	8.0674	0.1535	48.4	<.0001	0.05	7.7588	8.376
Year	2007	8.1072	0.1535	48.4	<.0001	0.05	7.7987	8.4158
Year	2008	8.1411	0.1535	48.4	<.0001	0.05	7.8326	8.4497
Year	2009	8.1683	0.1535	48.4	<.0001	0.05	7.8597	8.4769

Table 37. Yearly Change in Parameter Estimates

Differences of Least Squares Means									
Effect	Year	Year	Estimate	Standard Error	DF	Pr > |t|	Alpha	Lower	Upper
Year	1994	1995	-0.023	0.01379	666	0.0964	0.05	-0.05	0.00412
Year	1995	1996	-0.0462	0.01372	666	0.0008	0.05	-0.0732	-0.0193
Year	1996	1997	-0.0111	0.01363	666	0.4141	0.05	-0.0379	0.01563
Year	1997	1998	0.00322	0.01363	666	0.8133	0.05	-0.0236	0.02999
Year	1998	1999	-0.0384	0.01363	666	0.005	0.05	-0.0652	-0.0116
Year	1999	2000	-0.0327	0.01372	666	0.0176	0.05	-0.0596	-0.0057
Year	2000	2001	-0.0192	0.01365	666	0.1606	0.05	-0.046	0.00763
Year	2001	2002	-0.0203	0.01348	666	0.1329	0.05	-0.0468	0.00619
Year	2002	2003	-0.0131	0.01342	666	0.3284	0.05	-0.0395	0.01322
Year	2003	2004	-0.0055	0.01328	666	0.6772	0.05	-0.0316	0.02055
Year	2004	2005	-0.0105	0.0132	666	0.427	0.05	-0.0364	0.01543
Year	2005	2006	-0.0218	0.01328	666	0.1015	0.05	-0.0478	0.0043
Year	2006	2007	-0.0398	0.01334	666	0.0029	0.05	-0.066	-0.0137
Year	2007	2008	-0.0339	0.0135	666	0.0123	0.05	-0.0604	-0.0074
Year	2008	2009	-0.0272	0.01381	666	0.0494	0.05	-0.0543	-7E-05

Table 38. Natural Log of Pharmacist Supply Growth Estimate Over Time



Summary of Findings

The pharmacist supply was measured over time to attain an understanding of the environment's impact on it. Of the 13 hypotheses posited in this inquiry, five were accepted as a result of the empirical testing. The size of the population and the number of hospitals were the two variables found to be statistically significant when measuring munificence. Previous research has corroborated the empirical evidence found in this study that the population is a focal point when determining predictors of pharmacists supply (Knapp, Shah, & Barnett, 2010; Manolakis, & Skelton, 2010). The second hypothesis in munificence that was statistically significant was the number of hospitals.

It seems that the consensus among hospitals to address concerns related to rising multi-drug therapy regimens and medication safety is to employ additional pharmacists (Pederson, Schneider, & Scheckelhoff, 2009). This trend in one setting in which pharmacists work is characterized by its positive, linear association with the total number of pharmacists.

Employers with 20 or more employees and the number of insured were the variables found to be statistically significant when measuring concentration. Employers with 20 or more employees were found to be statistically significant. This result is further supported by previous empirical evidence that larger employers are more likely to offer health/medication coverage than smaller employers.

This leads to a potential causal relationship where larger employers equate to more coverage which translates to more prescription utilization and pharmacists. Empirical evidence from this inquiry provided the basis for accepting the hypothesis regarding the relationship between the number of insured and the total number of pharmacists. This finding is consistent with empirical findings in the extant literature on the pharmacist supply reported by previous investigators. Insurance coverage impact on the pharmacist supply is exemplified in two studies which showed that Medicare Part D helped make 14 to 30 million prescriptions available monthly at a cost savings to persons who may not have been able previously to afford their prescription drugs and it increased the probability of any prescription use by 9.6% (Kostick, 2006; Huh, Rice, & Ettner, 2008). In addition, other studies have reported an increase in prescription drug utilization and pharmacist workload when accounting for insurance coverage (Huh, Rice, and Ettner, 2008; & Geib, 2007).

The last hypothesis pertained to pharmacist growth over time. The pharmacist supply exemplified a change in supply over the timeframe analyzed with two segments of the timeframe being significant based upon the threshold established by the bonferonni correction. The results of the hypotheses are summarized in Table 39.

Table 39. Summary of Hypotheses Tested

Hypotheses	Variable	Status	F Value	Pr > F
	Munificence			
H1	Pop	Accepted	4.13	0.0426
H2	Pop65+	Rejected	3.4	0.0657
H3	Hosp	Accepted	7.51	0.0064
H4	PharmF	Rejected	2.23	0.1362
H5	Rx	Rejected	2.34	0.1263
H6	Phys	Rejected	0.49	0.4832
H7	MHI	Rejected	0.02	0.8976
	Concentration			
H8	HospC per 100,000 population	Rejected	2.86	0.0919
H9	PharmFC per 100,000 population	Rejected	0.11	0.7387
H10	OBDR per 100,000 population	Rejected	0.42	0.5184
H11a	EmpV	Rejected	0.03	0.8534
H11b1	EmpS1 (19 or less employees)	Rejected	0.84	0.3586
H11b2	EmpS2 (20 or more employees)	Accepted	5.15	0.0236
H12	Ins	Accepted	5.66	0.0176
	Density			
H13	Year	Accepted	104.1	1995 –1996, .0008 2006 – 2007, .0029

Chapter 6: Discussion

The purpose of this study was to assess the feasibility of using the population ecology theoretical framework to examine the impact of environmental factors on the pharmacist supply.

Munificence Results

The first environmental dimension, munificence, is addressed in hypotheses H1-H6. Hypothesis 1 addressed the impact of population size on the pharmacist supply. A test of H1 revealed that there is a positive, linear relationship between size of the residential population and the pharmacist supply; as a result H1 was accepted. This finding is consistent with other findings in the literature. The primary source for a pharmacist supply to sustain itself is a viable patient population. It is logical and reasonable to expect that as the size of the residential population increases there is likely to be a corresponding increase in the patient population. A larger patient population may lead to a greater demand for prescriptions to be dispensed and, thus, an increased demand for the services of pharmacists.

H2 focused on a subset of the population. This hypothesis addressed the impact of the elderly on the pharmacist's supply. The results were not statistically significant and, therefore, divergent from the expectations that the elderly (65+ years old) population could impact pharmacist supply. This was a surprising result considering the volume of prescriptions utilized by the elderly population, which has been referenced in previous studies (Kaiser Family Foundation, 2011; Stagnitti, 2007).

It is important to note that although this result was not significant, this population continues to grow and may be of interest as healthcare insurance policies are adjusted over the next several years. This surprising finding may be attributed to several environmental factors such as the impact of Medicare Part D and the fact that the baby boomer generation is just starting to comprise a substantial proportion of the elderly population. Future research focusing on environmental factors affecting the pharmacist supply should include a closer examination of these factors.

H3 addressed the impact of hospital facilities with pharmacies and was accepted. The increased utilization of hospital-based pharmacists on treatment teams appears to be a significant environmental factor that may impact the pharmacist supply. This finding points to the fact that pharmacists have a wider range of responsibilities in the hospital setting and they are expected to apply their extensive pharmaceutical expertise to ensure optimal drug therapy outcomes and to minimize medication errors in the hospital setting.

The impact of clinical pharmacists in hospitals has been documented in the literature and findings from this inquiry are consistent with previous empirical findings regarding the role of clinical pharmacists in hospital settings. In direct contrast to hospital settings, the number of retail pharmacies was not found to be a significant environmental factor affecting the pharmacist supply. H4 was rejected. This result was unexpected and surprising. The reason for this finding is not immediately clear. It will be imperative to include this variable in future research on environmental factors affecting the pharmacist supply. One possible explanation may be that retail pharmacies are utilizing alternative manpower solutions to meet growing demands for pharmacist services.

Retail pharmacies appear to be searching for and implementing innovative and creative solutions that involve an increased reliance on pharmacy technicians and advanced technology (automation, robotics, electronic transmission of prescriptions) to handle the growing volume of prescriptions to be filled. Such strategies may satisfy the demands of growing prescription volume while at the same time having a neutral or negligible economic impact on the bottom line of retail pharmacies. Although the implementation of advanced technology may initially be expensive, retail pharmacies may be able to realize greater profit margins in the long-term because pharmacy technicians are substantially less expensive than pharmacists. Future research will need to examine these strategic choices in greater detail so that there will be a clearer, empirically based understanding of their impact on the pharmacist supply. Downsides of these strategic decisions include an increased propensity for medication errors and reduced opportunities for pharmacist-patient interactions.

The volume of prescriptions being filled was not found to be a significant environmental factor impacting the pharmacist supply. Consequently, H5 was rejected. Previous findings in the extant literature on the pharmacist supply suggested that there indeed is a statistically significant, linear relationship between the number of prescriptions filled and the pharmacist supply. In light of the results from this inquiry, more empirical studies will be needed to clarify the impact of this variable on the pharmacist supply. One possible explanation for this finding is that, although the volume of prescriptions to be filled is growing, it has not reached the threshold at which its impact can be discerned in light of other environmental factors affecting the pharmacist supply. More empirical evidence is needed in order to reach more conclusive findings regarding prescription volume and the pharmacist supply.

It appears that there may be a significant interaction between prescription volume and the number of prescriptions that can be reasonably filled by a single pharmacist during a shift. Future studies should explore this possibility by including an interaction term in statistical models purporting to explain the impact of environmental factors on the pharmacist supply.

H6 explored the relationship between the physician supply and the pharmacist supply. The test of H6 revealed no statistically significant relationship between the total number of physicians and the pharmacist supply. Consequently, H6 was rejected. In light of the fact that physicians write the overwhelming majority of prescriptions to be filled in the U.S., it seemed logical that this environmental factor could have a statistically discernible impact on the pharmacist supply. It seems plausible that as the physician population increases there will be an increase in the number of prescriptions written and, in turn, an increased demand for pharmacists to keep pace with the growing volume of prescriptions to be filled. Although this association was not confirmed in this inquiry, future research should continue to explore this relationship.

The number of physicians, total number of pharmacists and the volume of prescriptions being written are all expected to continue to increase in coming decades. One possible explanation for the finding in this inquiry may be that, while physicians do write a large number of prescriptions, a large portion of these prescriptions may never be filled. Thus, there may not be a sufficient enough increase in prescription volume to increase the demand for pharmacists. Paramount among the reasons a patient may choose not to have one or more of their prescriptions filled is a lack of insurance or a means of paying to have a prescription filled.

Improved methodological approaches for exploring the relationship between the physician supply and the pharmacist supply may shed more light on this relationship and enable the ability to reach more tenable conclusions and consensus regarding the impact of the physician supply on the pharmacist supply. Such methodological approaches may include better predictive models and a means of controlling for possible intervening variables that could confound the presumptive relationship between the physician supply and the pharmacist supply in a population ecology framework.

Wealth of the community was the final environmental factor that was believed to have an impact on the pharmacist supply. It is hypothesized that there would be a positive, linear relationship between wealth of the community and the pharmacist supply. A test of H7 caused the rejection of this hypothesis. It was not a statistically significant relationship between wealth of the community (indicated by median household income) and the pharmacist supply in this inquiry. This finding contradicts our premise that increasing community wealth will lead to an increased demand for pharmacists. It was our contention that wealthier communities could better afford prescription medications and are more likely to get their prescriptions filled compared to less wealthy communities. Future research into the environmental factors impacting the pharmacist supply may need to test for an interaction effect involving number of prescriptions, insurance status and wealth. Additionally, future models may need to also control for community health status. It is well-known in the health services literature that health status and income (one indicator of wealth) are inversely related.

Concentration Results

Concentration describes the level to which resources are evenly distributed. H8 was the first hypothesis tested in the concentration dimension and it explored the relationship between hospital beds per 100,000 population and the pharmacist supply. This variable was not found to be statistically significant and lead to the rejection of H8. This finding is surprising in light of the fact that the number of hospitals was found to be a significant environmental factor impacting the pharmacist supply. Future research may need to explore the relationship between hospital size and the pharmacist supply to shed more light on how this dimension affects the pharmacist supply. One possible explanation for this finding may be that the number of hospital beds per 100,000 may not be as pertinent a point in measuring pharmacist supply as are factors within a hospital, such as the type of services they provide and their patient mix. These hospital attributes may prove to be more important antecedents to the pharmacist supply than the size of the hospital.

The number of pharmacies per 100,000 population was the next indicator of concentration that was examined in this inquiry and it was the focus of H9. As was the case for H8, a test of H9 did not yield statistically significant results and it was rejected. It seemed logical that as the ratio of pharmacy facilities to the population increase there would be more pharmacist positions to fill and, thus, the pharmacist supply would increase. The primary source for a pharmacist to sustain himself or herself is a viable patient population and the setting in which those services will be rendered. Community-based pharmacies would appear to meet that need for practicing pharmacists. Although not significant in this inquiry, this variable should be explored in future studies seeking to understand how environmental factors impact the pharmacist supply. It may be helpful in such studies to control for type of pharmacy facility (e.g., grocery stores, wholesale warehouses and mail-order).

The third indicator of concentration that was explored in this inquiry was the number of office-based physicians per 100,000 population. It is hypothesized that there is a positive, linear relationship between the number of office-based physicians per 100,000 population and the pharmacist supply. This relationship was the focus of H10. Based on the results from testing H10, it was rejected it and concluded that the number of office-based physician per 100,000 population is not a significant environmental factor affecting the pharmacist supply. Although the number of office-based physicians per 100,000 population continues to increase, it does not impact the growth of the pharmacists supply. This may be due to the supply of pharmacists being able to handle the increased volume of prescriptions at this juncture; possibly augmented by medication dispensing technology and pharmacy technicians (Adams, Martin, & Stolpe, 2011). The specific types of physicians along with their patient mix may provide a better barometer of how the number of office-based physicians per 100,000 population may impact the pharmacist supply and should be explored in more detail in future studies.

Hypotheses 11a and 11b address employer concentration levels. Employers are the primary source of health insurance coverage. H11a focused on employer volume (number of employers) and was rejected. The number of employers does not have a significant impact on the pharmacist supply. Although the numbers of employers was not found to be significant, employer size does appear to have a significant environmental impact on the pharmacist supply.

H11b1 and H11b2 focused on employer size, with H11b1 being rejected, and H11b2 being accepted based upon test results. Large employers (20 or more employees) were found to have a statistically significant effect on the pharmacist supply. Two separate repeated measures regression equations were solved to reach this conclusion. Results were not statistically significant for the equation that included employers with 19 or fewer employees. Large employers have at least two advantages over their smaller counterparts: (1) they are more able to offer health coverage and (2) they can offer better medication insurance coverage. Small employers who may have predominantly lower-wage workers are much less likely to offer health insurance since the greater cost of underwriting and administering coverage for each enrollee in a small workforce adds to the cost of the premium.

H12 addressed insurance coverage and was accepted based on test results. Insurance coverage was found to be a statistically significant environmental factor affecting the pharmacist supply. The impact of increased insurance coverage for prescription drugs has resulted in a significant increase in prescription volume. Health insurance is usually the primary source for paying for prescriptions. The ability to pay for prescriptions through insurance coverage plays a vital role in the volume of prescriptions to be filled, which in turn plays a role in the need for pharmacists. This result places emphasis on the importance of insurance as individuals decline filling prescriptions due to lack of insurance. Increased access to prescription drugs through insurance coverage appears to impact the pharmacist supply.

Density Results

Hypotheses H1-H12 explored the impact of munificence and concentration the pharmacist supply. H13 was the final hypothesis tested in this inquiry. A test of H13 sought to answer the question of whether there was a statistically significant change in the pharmacist supply over the 16-year time period of this inquiry. This question addresses the dimension of density in the population ecology theoretical framework.

In this inquiry the pharmacist supply was treated as an organization within the context of the population ecology theoretical framework. It is important to note that, while the environment plays a role in determining the ebb and flow of organizations, in this instance the pharmacist supply, it is important to determine what type of impact changes in the organization has on the organization over time. For instance, does the organization have different factions, and if so, what types of interactions exist among these factions (e.g. symbiosis, commensalism, competition). In the case of the pharmacists supply, it seems that if there are any factions they may likely be work milieu and degree of specialization. Competition at some level is plausible given the primary functions all pharmacists are capable of performing. However, this is most likely to occur when there is a scarcity of resources.

An examination of the possible factions mentioned above with regard to the pharmacist supply is beyond the scope of this inquiry. The test of H13 was performed to answer the question of whether there was a statistically significant change in the pharmacist supply between the first year of the time period for this inquiry (1994) and the last year (2009). If that is the case, there will be some indication of the extent to which the past pharmacist supply impacts future supply.

Hypothesis 13 was accepted and it was concluded that the past pharmacist supply does impact the future supply. Future studies will need to consider the roles of the factions mentioned above in this relationship. Overall, the pharmacist supply continued to rise at a consistent pace across the years in the period of time covered by this inquiry. Aside from the statistically significant change in the pharmacist supply between 1994 and 2009, there was a significant change for two other years within the time period for this inquiry when the bonferonni correction was applied: 1995-1996 and 2006-2007.

Possible reasons for the continuous growth of the pharmacist supply between 1994 and 2009 include: (1) expansion of the scope of practice, (2) expanded practice settings, (3) an increase in the number of pharmacy schools and increased class sizes within schools and (4) a higher influx of international pharmacy graduates who meet licensure requirements and become licensed to practice in the U.S.

Summary of Hypothesis Testing

H1-H7 addressed the munificence dimension of the population ecology framework. H8-H12 addressed the concentration dimension. H1 and H3 were accepted and it was concluded that the size of the population and the number of hospitals are significant munificence factors affecting the pharmacist supply.

H11b2, H12 and H13 were accepted. Employers with 20 or more employees and having insurance were found to be significant concentration factors affecting the pharmacist supply between 1994 and 2009. Previous pharmacist supply was found to significantly affect future supply.

Implications

Theoretical Implications.

The theoretical framework utilized in this inquiry has been used by organization theorists to determine how environmental factors impact organizations in the restaurant, newspaper and health care industries in the past. The population ecology theory has both benefits and limitations when it is applied to the study of the pharmacist supply. Among the benefits, the population ecology theory enables the ability to explore the impact of environmental factors on the pharmacist supply overall as well as specific subsets of it (e.g., mail order pharmacists, retail pharmacists). The inclusion of carrying capacity helps to ensure that the role of the environment on the pharmacist supply can be explored in terms of dimensions such as munificence (e.g., the residential population) and concentration (e.g., pharmacies per 100,000 population).

The use of the population ecology framework in this inquiry provides an opportunity to expand the use of this theory to shed more empirical light on the impact of environmental factors on the healthcare workforce. The exploration of the density construct within the healthcare industry is particularly promising. In density, all organizational members are assumed to be equivalent in terms of measuring competition for resources. This, however can have the ability to lead to some misinterpretation due to the fact not all members of an organization are equally competitive. A second area in which the population ecology theory may not be beneficial in the measurement of the pharmacist supply is where a pharmacist may have two competing roles such as a retail pharmacist at day and a mail order pharmacist at night serving the same population. For instance how can the size of populations or resource space be determined if they work as retail pharmacists during the day and mail order pharmacists at night servicing the same geographical population?

Future studies should include an analysis of specialties within the profession of pharmacy and additional healthcare providers that may impact the pharmacist supply.

Methodological Implications.

Treating the pharmacist supply as an organization and examining it within the population ecology theoretical framework appears to have been a suitable methodological approach for examining environmental factors affecting the pharmacist supply. The profession of pharmacy is broad enough in scope so that it is amenable to being examined from the perspective of the various dimensions of the population ecology theory.

Growing specialization within the profession has expanded the practice settings for pharmacists and they can be found in a number of settings in which they are able to perform basic and advanced functions. Although the population ecology framework has been used in previous studies of various industries, its use in the healthcare industry has been limited. This framework was particularly amenable to employing repeated measures as a means of testing empirically based hypotheses to shed light on how various environmental dimensions affect the pharmacist supply over time (e.g., munificence, concentration and density).

Understanding how the pharmacist supply is impacted individually and collectively by environmental factors will yield fertile ground for more sophisticated statistical and methodological approaches to examine this topic in the future. The use of a 16-year time frame for this inquiry was a noteworthy departure from previous studies that have used as few as two years. Longer time periods allow the ability to obtain a more accurate picture of the impact of environmental factors on the pharmacist supply.

Health Policy Implications.

The pharmacist workforce continues to grow and diversify into a myriad of disciplines as demands for pharmaceutical services has entered specialty areas such as geriatrics, oncology, and radioactive pharmaceuticals.

Numerous studies have reported that an increase in prescription drug utilization and pharmacist workload occurs when the proportion of the resident population with insurance coverage increases. The passage of the Affordable Care Act and its gradual implementation over the next several years is expected to have a very significant and discernible impact on this well established relationship. It is estimated that 32 million previously uninsured people will become insured as a result of the Affordable Care Act. No doubt this fact will significantly change the pharmacist workforce landscape. It is likely that with the growth in insurance coverage, the pharmacist supply will grow as well and pharmacists will be presented with additional practice opportunities in more practice settings. Another environmental factor that could potentially impact the pharmacist supply in coming years is the increase in the elderly segment of the residential population. Although this was not found to be a significant environmental factor in this inquiry, it should be explored in future studies of the pharmacist supply as it has been found to be significant in past studies. If it is a significant environmental factor, it will no doubt have a profound impact on the pharmacist supply with important health care policy implications.

The practice of defensive medicine is a third environmental factor that may warrant exploration in futures studies of the pharmacist supply in the context of the population ecology theory. Defensive medicine refers to situations in which physicians prescribe medications to ensure that they have covered every possibility; even in circumstances wherein prescription medications may not be indicated.

The implementation of Medicare Part D is projected to result in an increase of 14 to 30 million prescriptions to be filled monthly (Kostick, 2006). While the healthcare reform act will not just provide healthcare services to the elderly, one must be cognizant of the potential increase in the prescription volume and the demands that are accompany this influx of potentially new patients.

Managerial/Administrative Implications.

Growth in the pharmacist supply as a result of the reasons mentioned above has implications for healthcare executives, managers and personnel administrators. These individuals will face various challenges as they strive to manage a larger, increasingly more complex pharmacist workforce. They will need to keep abreast of changes in their environment as they attempt to meet the needs of their professional workforce and dynamic patient/customer population. An understanding of the demographic changes in their complex work environments will enable executives and managers to respond more rapidly and appropriately to their practice environments. A thorough knowledge of their work and practice environments will enable them improve patient care and healthcare efficiency.

Pharmacy managers may need to develop more innovative strategies and pursue new means of finding and hiring pharmacists to meet the needs of their practices (e.g., professional recruitment agencies). Pharmacy schools have increased their class sizes in an attempt to meet the needs for pharmacist's services in a growing resident population.   Hospitals managers will possibly need to award bonuses and other incentives to attract new hires, which may include payment for relocation expenses and tuition assistance. It is imperative for pharmacy schools to align their programs to meet the demands of hospitals as they try to curtail medication errors and decrease mortality and morbidity rates.

The number of large employers and the number of insured both impact the pharmacist supply. Large employers are more apt to provide insurance coverage, hence the potential to increase prescriptions. Incentives directed toward retention and recruitment would be the staple for managers where they may have to utilize salary increases, stay-on bonuses, and tuition assistance for pharmacists. An additional bargaining tool may be the current or future influx of large employers which will increase the hiring organization's argument that they will have not only a sufficient workload, but possibly the ability to give presentations at these facilities on various medication topics. The questions that help determine and form their strategic goals/plans are: how many pharmacists are needed at my hospital and will it improve the quality of care in the community? Is the number of pharmacists in my community sufficient to address the number of insured and physicians in the geographical area? Evaluating one's environmental needs will help to ensure that a practical plan is developed. This should help to guarantee that an appropriate number of pharmacists are available to meet the current and changing demands of their surrounding environment.

Limitations

The data used in this inquiry came from a number of sources. While the data were sufficient to conduct the tests described in this inquiry, it should be noted that the two limitations of the data. The first limitation relates to the prescription fill data obtained from NACDS.

NACDS data come only from retail pharmacies that are members of the association. Future studies should attempt to use as many sources as possible in order to get the most accurate, comprehensive, unduplicated prescription fill data available.

Although the NACDS prescription fill data were sufficient for this inquiry, it should also be noted that the conclusions are based on using these data may not be as generalizable as might have been preferred. NACDS members represent a subset of prescription fill data sources in the U.S. There is no single retail database of prescription fill data in the U. S. Should such a database become available in the future, it will be very useful for inquiries such as this one. The best source of data on prescriptions filled in institutional settings comes from medication orders in hospitals. As is the case with retail prescription fills data, there is no single source of prescription fill data for institutions. One problem with medication orders data is that a single medication order may represent one to twenty separate prescriptions (DHHS, 2000). The availability of more representative prescription fill data will greatly enhance studies of the pharmacist supply in the future.

The second limitation of the data used in this inquiry was that there was no inclusion of pharmacy technicians. Pharmacy technicians can perform a variety of tasks under the supervision of a pharmacist. It is reasonable to assume that if a single pharmacist can supervise a number of pharmacy technicians at a time, there may be less of a need for pharmacists and this will impact the pharmacist supply.

Future studies of environmental factors impacting the pharmacist supply should include data on pharmacy technicians. These health care workers have extensive training and provide extensive support in the practice environment (Manasse & Speedie, 2007). There does not seem to be an accurate source for tracking the technician workforce. The inclusion of more representative prescription fill data and data on pharmacy technicians should greatly enhance future studies of the pharmacist supply and factors that impact it.

Future Research

The primary goal of this inquiry was to determine the feasibility of using the population ecology theory to explore the impact of environmental factors on the pharmacist supply in the U.S. Thirteen hypotheses were generated from a review of the literature and tested in this inquiry. H1-H7 examined factors from the munificence construct of the population ecology theory. As a result of testing these hypotheses H1 and H3 were accepted and it was concluded that the size of the residential population and the number of hospital facilities are significant munificence factors impacting the pharmacist supply.

H8-H12 examined the concentration construct of the theory. Tests of these hypotheses resulted in acceptance of H11b2 and H12. It was concluded that employers with 20 or more employees and having health insurance significantly impact the pharmacist supply. With regard to density, H13 was accepted and it was concluded that past pharmacist supply significantly impacts future pharmacist supply.While the findings from this inquiry are believed to be contributions to the literature on environmental factors affecting the pharmacist supply, future research should also take into account several additional variables. The first of these is physician specialty (e.g. orthopedics, surgery, psychiatry etc.). The physician population was not found to be a significant factor affecting the pharmacist supply in this inquiry. The inclusion of physician specialty in future research may shed more light on the impact of this variable. Second, if the data are available, it would be informative to have more data on pharmacist practice settings and include such data in predictive models (e.g. retail pharmacists, mail-order pharmacists).

Third, instead of using a dichotomous variable for insurance coverage, it might be insightful to use type of coverage (e.g. HMO, PPO, etc). Fourth, if the data are available, it would be advantageous to include information on pharmacy technicians in future studies. Pharmacy technicians comprise an integral component of manpower in hospital and retail pharmacy settings. The inclusion of pharmacy technician data in future studies is very important because increasing number of states are introducing and enacting laws to expand the scope of practice of pharmacy technicians. One example of this emerging trend is a tech-check-tech (TCT) system, where a technician's accuracy is reviewed by another technician as opposed to a pharmacist (Adams et al., 2011; Reed, Thomley, Ludwig, & Rough 2011). This trend may have a very significant impact on the pharmacist supply in the future and should be explored empirically.

Technology used in various pharmacy settings continues to evolve. Future research must examine the impact of evolving technology in order to more fully understand how it impacts the pharmacist supply. One example of this technology is the use of dispensing machines. Central-fill pharmacies may be a viable option to handle an increasing demand for pharmacist services in coming decades. This increase in demand for pharmacist services has been precipitated by a growing volume of prescriptions to be filled, especially in retail settings in the community.

Future research into the environmental factors affecting the pharmacist supply must include a close examination of the trend toward central fill pharmacies and the technologies that they employ (e.g. increase use of dispensing machines) in order to fully understand how it may impact the pharmacist supply. A mixed methods approach, involving both qualitative and quantitative modalities, should be used in conjunction with the repeated measures regression used in this inquiry to explore this variable.

Within the context of the population ecology theoretical framework, central fill pharmacies appear to be related to the density and concentration constructs. It will be particularly interesting to examine this trend toward central fill pharmacies after 2009, the last year in the period for this inquiry.

Finally, this inquiry examined the impact of environmental factors on the pharmacist supply from a national perspective. It may be useful in future inquiries to examine these factors by looking at regions or other sub national levels (e.g., metropolitan statistical areas, census tracks, rural areas, etc.). By doing so it maybe plausible to provide a more detailed description of environmental factors and their impact on pharmacist supply in the local practice environment.

References

Abraham, J., Feldman, R., Carlin, C., Christianson, J., Davis, L. (2005). Are Employees Informed About Their Healthcare Coverage? Evidence from the Buyers Health Advisory Group. *Managed Care Interface*, *7*, 29-36.

Adami,C., Ofria, C. & Collier, T.C. (2000). Evolution of biological complexity. *Proceedings National Academy of Science, 9(97),* 4463-4468.

Adams, A.J., Martin, S.J., & Stolpe, S.F. (2011). “Tech-check-tech”: A review of the evidence on its safety and benefits. *American Journal of Health-System Pharmacy,* 68, 1824-33.

Alexander, J.A., & Amburgey, T.L. (1987).The Dynamics of Change in the American Hospital Industry: Transformation or Selection? *Medical Care Research and Review*.*44(2),* 279-321.

Amburgey,T.L., & Rao, H. (1996).Organizational Ecology: Past, Present, and Future Directions. *The Academy of Management Journal, 39(5),* 1265-1286.

American Association of College of Pharmacy (2010). Year each school of pharmacy was founded.

American College of Clinical Pharmacy. (2008). The Definition of Clinical Pharmacy. *Pharmacotherapy*, *28(6),* 816–817.

American Society of Health-System Pharmacists. (2007). ASHP Long-Range Vision for the Pharmacy Work Force in Hospitals and Health Systems. *American Journal of Health System Pharmacists. 64,* 1320-30.

American Society of Health-System Pharmacists. June 2001. Medication use among older Americans. Retrieved from www.ashp.org/pr/over65.pdf

AMN Healthcare (2009). *Clinical Workforce Issues: 2009 Survey of Chief Executive Officers.* San Diego, CA: Author.

Anderson, Jr., H. C., & Crawford, A. (2010). Central-Fill Pharmacies and Processes. Retrieved from http://www.nodakpharmacy.com/pdfs/centralFill.pdf.

Bacharach, S.B. (1989). Organizational Theories: Some Criteria for Evaluation. *The Academy of Management Review, 14(4),* 496-515.

Baran, R.W., Shaw, J., & Crumlish, K. (1998). Pharmacy students expectations for professional practice, *Managed care Interface, 11(8),* 50-5.

Baum, J.A.C., & Singh, J.V. (1994) Organization-Environment Coevolution. *The Evolutionary Dynamics of Organizations,* New York, NY, Oxford University Press.

Berardi, R.R, McDermott, J.H, Newton, G.D., Kroon, L.A., Oszka, M.A., & Poppovich, N.G. et al. (2004). *Handbook of nonprescription drugs*. (14th Ed). Washington DC: American Pharmacists Association.

Besier, J.L., & Jang, R. (1992). Factors affecting practice area choices by pharmacists in the Midwest, *American Journal of Hospital Pharmacy, 49(3),* 598-602.

Bond, C. A., Raehl, C.L., & Franke, T. (1999). Clinical pharmacy services and hospital mortality rates, *Pharmacotherapy, 19(5),* 556-564.

Bowler, P.J. (2009). Darwin's Originality, *Science, .323,* 223-226.

Brooks,G.R.& Jones V.G.(1997). Hospital Mergers and Market Overlap. *Health Services Research. 31(6*). 701-722.

Brown, H., & Prescott, R. (2006) *Applied Mixed Models in Medicine 2nd Ed*. Hoboken, NJ, John Wiley & Sons, Ltd.

Brown, J.N., Barnes, C.L., Beasley, B., Cisneros, R., Pound, M., & Herring, C. (2008). Effect of pharmacists on medication errors in an emergency department. *American Journal of Health-System Pharmacy, 65*, 2008.

Burt, C. W. (2002) National trends in use of medications in office-based practice, 1985-1999. *Health Affairs (Millwood) Jul-Aug, 21(4)*, 206-14.

Buscher, M. (2005, July 11). Pharmacist Shortage to Blame for Pharmacy Closings. Retrieved from http://www.wral.com/news/local/story/118387/

Carroll, G.R. (1985). Concentration and Specialization: Dynamics of Niche Width in Populations of Organizations. *The American Journal of Sociology, 90(6),* 1262-1283.

Carroll, G.R. (1981). Dynamics of Organizational Expansion in National Systems of Education. *American Sociological Review, 46 (5),* 585-599.

Carroll, G.R. (1984). Organizational Ecology. *Annual Review of Sociology, 10,* 71-93.

Chain Drug Review.(2010). Central Fill Promises to Make Pharmacies More Efficient . Retrieved from http://www.innovat.com/pdf/cdr_centralfill_july2010.pdf.

Cherry, D.K., Woodwell, D.A., & Rechtsteiner, E.A., (2007).Advanced Data from vital health statistics. *National Ambulatory Medical Care Survey:2005 Summary, 387*.

Christensen, D.B., & Farris, K.B. (2006). Pharmaceutical Care in Community Pharmacies:Practice and Research in the US. *The Annals of Pharmacotherapy.July/August (40),* 1400-1406.

Cooksey, J.A., Walton, S.M. Stankewicz, T., & Knapp, K.K. (2003). Pharmacy School Graduates by State and Region: 1990-1999. *Journal of the American Pharmacists Association, 43(4),* 463-469.

Cox, E.R & Fitzpatrick, V. (1999). Pharmacists' job satisfaction and perceived utilization of skills. *American Journal of Health System Pharmacy, 56*, 1733-37.

Crimmel, B.L. and Sommers, J., *Employer-Sponsored Health Insurance for Large Employers in the Private Sector, by Industry Classification, 2006*. Statistical Brief Number211. July 2008. Agency for Healthcare Research and Quality, Rockville, MD, http://www.meps.ahrq.gov/mepsweb/data_files/publications/st211/stat211.pdf

Cunningham, P.J. (2002). Prescription Drug Access: Not Just A Medicare Problem. Center for Studying Health System Change. Retrieved from www.hschange.org.

Darwin, C. R. 1859. *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. London: John Murray. 1st edition, 1st issue.

Dastani, H.B., & Siganga, W.W., (2003). Hospital pharmacy directors' perceptions of hospital mergers and strategic alliances. *American Journal of Health System Pharmacy, 60*, 2245-7.

DeNavas-Walt, C., Proctor, B.D., & R.J. Mills (2004). Income, Poverty, and Health Insurance Coverage in the United States: *2003*

Deyton, P., Edwards, J.M., Eiland, L.S., Fried, B., Gallagher, R.M., & Mahaney, L.M., et al. (2007). Report of the ASHP task force of pharmacy changing demographics. *American Journal of Health System Pharmacy. 64(12)*, 1311-9.

Dorschner, K.W. Fox, S.F. Keener, M.S., & Eikenbary, R. D. (1987). Lotka-Volterra Competition Revisited: The Importance of Intrinsic Rates of Increase to the Unstable Equilibrium. *Oikos, 48 (1),* 55-61**.**

Ellitt, G.R., Brien, J.E., Aslani, P., & Chen, T.F. (2009). Quality Patient Care and Pharmacists' Role in Its Continuity—A Systematic Review. *The Annals of Pharmacotherapy*. *April Vol 43,* 677-691.

Freeman, J. & Hannan, M.T. (1983). Niche Width and the Dynamics of Organizational Populations. *The American Journal of Sociology, 88(6),* 1116-1145.

Freeman, J. & Hannan, M.T. (1989). Setting the Record Straight on Organizational Ecology: Rebuttal to Young Author(s). *The American Journal of Sociology, 95 (2),* 425-439.

Fryer, Jr, G.E., Green, L.A., Dovey, S.M., Yawn, B.P., Phillips, R. L., & Lanier, D. (2003) Variation in the Ecology of Medical Care. *Annals of Family Medicine*, 1(2), 81-89.

Gavrilets, & Losos, J.B. (2009). Adaptive Radiation: Contrasting Theory with Data. *Science, 323*, 732-737.

Geib, G. (2007). Prescription Volume May Exceed Safe Capacity. *Medical News Today*. Retrieved from http://www.medicalnewstoday.com/releases/68892.php.

Gershon, S.K., Cultice, J.M., & Knapp, K.K. (2000). How Many Pharmacists Are in Our Future? The Bureau of Healthy Professions Projects Supply to 2020. *Journal of the American Pharmacists Association, 40(6),* 757-64.

Gore, J., & Seeds, Nicole (2004). Medicare prescription drug improvement and modernization act of 2003 (MMA). *Virginia Legislative Issue Brief. 38.*

Guchelaar, Henk-Jan, Colen, H. B.B., Kalmeijer, M.D., Hudson, P.T.W., & Teepe-Twiss, I.M. (2005). Medication Errors Hospital Pharmacist Perspective. *Drugs, 65 (13),* 1735-1746.

Hannan, M.T., & Freeman, J. (1984). Structural Inertia and Organizational Change. *American Sociological Review, 49*, 149-164.

Hannan, M.T., & Freeman, J.(1977).The Population Ecology of Organizations *The American Journal of Sociology, 82(5),* 929-964.

Hardigan, W.D., Slywka, G.W.A., & Eng, H.J. (1980). Distribution and cost of drugs in a pharmaceutically decentralized health maintenance organization, *Contemporary Pharmacy Practice, 3(1),* 23-30.

Hasenfeld, Y. (1992). *Human Services as Complex Organizations*. Sage Publications, Inc; 1 edition.

Ho, V., & Hamilton, B.H. (2000).Hospital mergers and acquisitions: does market Consolidation harm patients?. *Journal of Health Economics, 19,* 767–791.

Huh, S., Rice, T., & Ettner, S.L. (2008). Medicare and the Elderly Prescription Drug Coverage and Effects on Drug Expenditures among Elderly Medicare Beneficiaries. *Health Services Research*, 43(3), 810-832.

Hurley, R.E., & Kaluzny, A.D. (1987). Organizational Ecology and Health Services Research: New Answers for Old and New Questions. *Medical Care Research and Review, 44(2),* 235-255.

Institute of Medicine. (2000). To Err is Human: Building a Safer Health System.. *National Academy Press*, Washington, DC.

Jiang, H. J.& Begun, J.W. (2002). Dynamics of change in local physician supply: an ecological perspective. *Social Science & Medicine, 54,* 1525–1541.

Kaboli, P.J., Hoth,A.B., McClimon, B.J., & Schnipper, J.L. (2006). Clinical Pharmacists and Inpatient Medical Care: A Systematic Review. *Archives of Internal Medicine*, 166, 955-964.

Kaiser Family Foundation. (2000). *Prescription Drug Trends a Chart Book*. Menlo Park, California: Author.

Kaiser Family Foundation. (2011). Retail Prescription Drugs Filled at Pharmacies (Annual per Capita by Age), 2010. Retrieved from www.kff.org.

Kaiser Family Foundation (2007). Annual Survey Employer Health Benefits. publication (Number7672). Retrieved from www.kff.org.

Kaiser Family Foundation. (2009). The Uninsured and the difference health insurance makes. publication (Number1420-11). Retrieved from www.kff.org.

Knapp, D. (2002). Professionally Determined Need for Pharmacy Services in 2020. *American Journal of Pharmacy Education, 66,* 421-429.

Knapp, K.K. (1999). Charting the demand for pharmacists in the managed care era. *American Journal of Health-System Pharmacy, 56,* 1309-1314.

Knapp K.K. (2001). Pharmacist Workforce Challenges: Exploring Today's Manpower Shortage. *Cardinal Health*. Dublin, OH.

Knapp, K.K. & Cultice, J.M. (2007). New Pharmacist Supply Projections: Lower Separation Rates and Increased Graduates Boost Supply Estimates. *Journal American Pharmacists Association, 47(4),* 463-470.

Knapp, K.K. & Livesey, J.C. (2002). The Aggregate demand index: Measuring the balance between supply and demand 1999-2001. *Journal of the American Pharmacists Association, 42(3),* 391-8.

Knapp, K.K. Paavola, F.G, Maine L.L, Sorofman B., & Politzer R.M. (1999). Availability of primary care providers and pharmacists in the United States. *Journal of the American Pharmacists Association. 39(2),* 127-35.

Knapp, K.K., Quist, R.M., Walton, S.M., & Miller, L.M. (2005). Update on the pharmacist shortage: National and state data through 2003. *American Journal of Health System Pharmacy. 62(5),* 492-99.

Knapp, K.K., Shah, B., & Barnett, M. (2010). The Pharmacist Aggregate Demand Index to Explain Changing Pharmacist Demand Over a Ten-Year Period. *American Journal of Pharmaceutical Education,* 74*(10),* 1-8.

Kohn, L.T., Corrigan, J.M., & Donaldson, M.S. (2000). *To Err Is Human Building a Safer Health System*. Institute of Medicine National Academy Press Washington, D.C.

Kong, S. X. (1995). Predictors of Organizational and Career Commitment Among Illinois Pharmacists. *American Journal of Health System Pharmacists, 52,* 2005-11.

Kostick, J.H. (2006). Pharmacy Careers: A Prescription for Change. *Medscape Pharmacists.* Retrieved from http://www.medscape.com/viewarticle/545079_2

Kreling, D.H., Mott, D.A., Wiederholt, J.B., Lundy, J., Levitt, L. (2000). Prescription Drug Trends a chartbook. *The Henry J. Kaiser Family Foundation*. Washington, DC.

Langston, N. (1987). Niche Theory and Social Movements: A Population Ecology *Approach. Sociological Quarterly, 28(1),* 51-70.

Levy, S. (2008). Pharmacy salary information: Average earnings over $100,000. *Drug Topics*. Retrieved from http://www.modernmedicine.com/modernmedicine/Business+and+Management/Pharmacy-salary-information-Average-earningsover/ArticleStandard/Article/detail/500075

Lotka.A. (1925) Elements of physical biology. New York: Dover.

MacLaren, R. & Bond, C.A. (2009). Effects of Pharmacist Participation in Intensive Care Units on Clinical and Economic Outcomes of Critically Ill Patients with Thromboembolic or Infarction-Related Events. *Pharmacotherapy. 29 (7),* 761-768.

Manasse, H.R & Speedie, M.K. (2007). Pharmacists, Pharmaceuticals, and Policy Issues Shaping the Work Force in Pharmacy. *American Journal of Health System Pharmacy, 64(12),* 30-48.

Manolakis, P., & Skelton, J., (2010). Pharmacists' Contributions to Primary Care in the United States Collaborating to Address Unmet Patient Care Needs: The Emerging Role for Pharmacists to Address the Shortage of Primary Care Providers. *American Journal of Pharmaceutical Education,* 74*(10),* 1-9.

Matzke, G.R.(2009). Healthcare Reform 2009 and Its Implications for Pharmacists. *The Annals of Pharmacotherapy ,43,* 2088-2092.

Matzke, G.R. & and Ross, L.A. (2010). Health-Care Reform 2010: How Will It Impact You and Your Practice? *The Annals of Pharmacotherapy, 44*, 1485-1491.

McKelvey, B. & Aldrich, H. (1983). Populations, Natural Selection, and Applied Organizational Science. *Administrative Science Quarterly, 28(1),* 101-128.

Medco (2010). Drug Trend Report 2010 Vol 12: Solving the cost/Quality Equation Retrieved from http://www.drugtrend.com/art/drug_trend/pdf/DT_Report_2010.pdf

Medical Expenditure Panel Survey. (2008) Retrieved from http://meps.ahrq.gov/mepsweb/data_stats/MEPSnetHC.jsp

Medical Expenditure Panel Survey. (2010). 2008 Office-Based Medical Provider Visits. Rockville (MD): *Agency for Healthcare Research and Quality*. Retrieved from http://www.meps.ahrq.gov/mepsweb/.

Meissner, B.,Harrison, D., Carter, J., & Borrego, M. (2006). Predicting the impact of Medicare Part D implementation on the pharmacy workforce. *Social and Administrative Pharmacy, 2*, 315-328.

Mott, D.A., Doucette, W.R., Gaither, C.A., Kreling, D.H., Pedersen, C.A., & Schommer, J.C. (2005). N*ational pharmacist workforce survey.* Midwest Pharmacy Workforce Research Consortium. Retrieved from http://www.aacp.org/Docs/MainNavigation/Resources/7296_ExecsummforAACP.pdf

Mott, D.A., Doucette, W.R., Gaither, C.A., Pedersen, C.A., & Schommer, J.C. (2002). A ten year trend analysis of pharmacist participation in the workforce, *American Journal of Pharmaceutical Education, 66(3),* 223-233.

Mott, D.A., Doucette, W.R., Gaither, C.A., Pedersen, C.A., Kreling, D.H. & Schommer, J.C. (2006). Pharmacist Participation in the Workforce: 1990, 200, and 2004. *American Journal of Pharmacists Association, 46,* 322-330.

Mott, D.A., & Kreling, D.H. (1994). An internal rate of return approach to investigate pharmacist supply in the United States. *Health Economics, 3*, 373-384.

Namboodiri, K. (1994).The Human Ecological Approach to the Study of Population Dynamics. *Population Index, 60(4),* 517-539.

National Association of Boards of Pharmacy (2008). Census of Pharmacists-Pharmacies. Survey of Pharmacy Law, Mount Prospect, IL.

National Association of Boards of Pharmacy (2010). Census of Pharmacists-Pharmacies. Survey of Pharmacy Law, Mount Prospect, IL.

National Association of Chain Drug Stores. (2007) *Chain Pharmacy Employment Survey.* Retrieved from http://www.nacds.org/wmspage.cfm?parm1=4782.

National Association of Chain Drug Stores. (2011) *Who We Are.* Retrieved from http://www.nacds.org/wmspage.cfm?parm1=373

National Association of Chain Drug Stores. (2008, January). *2007 Community Pharmacy Results.* Alexandria, VA.

Nielsen, F., & Hannan, M.T. (1977). The Expansion of National Educational Systems: Tests of a Population Ecology Model. *American Sociological Review, 42(3),* 479-490.

Pal, S.(2002). Pharmacist Shortage to Worsen in 2020. *US Pharmacist, 27(12).* Retrieved from http://www.uspharmacist.com/

Patry, R.A., & Eiland, L.S. (2007). Addressing the shortage of pharmacy faculty and clinicians: The impact of demographic changes. *American Journal of Health System Pharmacy, 64(7),* 773-5.

Pedersen. C.A., Doucette. \V.R.. Gaither C, Mott. D.A. and Schommer, J.C., National Pharmacist Workforce Survey: 2000, *Pharmacy Manpower Project. Inc.* Retrieved from http://www.aacp.org/site/page.asp?TRACKID=&VID=1&CID=503&DID=3897

Pedersen, C.A, Schneider, P.J, & Santell, J.P. (2001). ASHP national survey of pharmacy practice in hospital settings: Prescribing and transcribing—2001. *American Society of Health-System Pharmacists,* 58, 2251-2266.

Pedersen, C.A, Schneider, P.J, & Scheckelhoff, D.J. (2009). ASHP national survey of pharmacy practice in hospital settings: Dispensing and administration—2008. *American Society of Health-System Pharmacists,* 66, 926-946.

Pedersen, C.A, Schneider, P.J, & Scheckelhoff, D.J. (2012). ASHP national survey of pharmacy practice in hospital settings: Dispensing and administration—2011. *American Society of Health-System Pharmacists,* 69, 768-785.

Poisal, J.A., & Chulis, G. S. (2000).Medicare Beneficiaries and Drug Coverage. *Health Affairs. 19(2),* 248-256.

Polit, D., & Beck, C. T. (2004). *Nursing Research: Principles and Methods.* (7th ed.). Philadelphia: Lippincott.

Rajecki, R. (2010). Drug Topics' 2010 pharmacists salary survey *Drugtopics*. Retrieved from http://www.modernmedicine.com/modernmedicine/Modern+Medicine+Now/iDrug-Topicsi-2010-pharmacists-salary-survey/ArticleStandard/Article/detail/664501

Ranji, U.R., Wyn, R, Salganicoff, A., & Yu, H. PhD. (2007). Women's Health Issues. Role of Health Insurance Coverage in Women's Access to Prescription *Medicines, 17(6),* 360-366.

Reed, M. (2005). An update of American access to prescription drugs. *Health System Change. May (95),* 1-4.

Reed, M. & Hargraves, J.L. (2003). Prescription Drug Access Disparities Among Working-Age Americans. *Health System Change. December (73*, 1-4.

Reed. M., Thomley, S., Ludwig, B., & Rough, S. (2011). Experience with a "tech-check-tech" program in an academic medical center. *American Journal of Health-System Pharmacy,* 68, 1820-3.

Reissman, D. (2004). Winners and losers under medicare part D. *Drug Benefit Trends, 16(4), 406*-407.

Ricciuti, J.S., (2001). The Shortage of Pharmacists in the United States. *Medscape Pharmacists*. Retrieved from http://www.medscape.com/viewarticle/431696

Ringold, D.J., Santell, J.P., & Schneider, P.J. (2000). ASHP national survey of pharmacy practice in acute care settings: Dispensing and administration—1999. *American Journal of Health System Pharmacy, 57,* 1759-1775.

Rosenthal, M.B., Zaslavsky, A., & Newhouse, J.P. (2005). The Geographic Distribution of Physicians Revisited. *Health Services Research, 40(6),* 1931-1952.

Rundall, T.G., & McClain, J.O. (1982). Environmental Selection and Physician Supply. *The American Journal of Sociology, 87(5*), 1090-1112.

Rundall, T.(1987). The Organization of Medical Practice: A Population Ecology. *Perspective Medical Care Research and Review,* 44(2), 375-405.

Schluter, D. (2009). Evidence for Ecological Speciation and Its Alternative. *Science 323,* 737-740.

Schommer, J.C., Singh, R.L., Cline, R.R., & Hadsall, R.S. (2006). Market dynamics of community pharmacies in Minnesota. *Research in Social and Administrative Pharmacy, 3(2),* 347-358.

Schommer, J.C., Sogol, E.M, & Brown, L.M. (2007). Career pathways for Pharmacists. *Journal of the American Pharmacists Association, 47(5)*, 563-564.

Schondelmeyer, S.W., Mason, H.L., Miller, C.S., & Kibbe, A.H.(1992). Final Report of the National Pharmacists' Compensation Survey: 1990-91. *American Pharmacy, 32(1),* 38-45.

Shane, R. & Gouveia, W. (2009). The dilemma of establishing effective pharmacy staffing levels. *American Journal of Health System Pharmacists. 66,* 2103.

Shih, Y.C. (1999). Growth and geographic distribution of selected health professionals, 1971-1996. *Journal of Allied Health, 28(2),* 61-70.

Sing M, Miller E, Banthin JS. Estimated Effects of Increased Coverage on Prescription Drug Expenditures among Seniors. Agency for Healthcare Research and Quality Working Paper No. 08005, March 2008. Retrieved from http://gold.ahrq.gov

Smart, D. (2010). *Physician Characteristics and Distribution in the US*, 2010 Edition American Medical Association; Chicago, IL.

Sommers, J. *Employer-Sponsored Health Insurance for Large Employers in the Private Sector, by Industry Classification, 2002.* Statistical Brief Number 47. July 2004. Agency for Healthcare Research and Quality, Rockville, MD. Retrieved from http://meps.ahrq.gov/mepsweb/data_files/publications/st47/stat47.htm

Sommers, J and Crimmel, B. *Employer-Sponsored Health Insurance for Small Employers in the Private Sector, by Industry Classification, 2006*. Statistical Brief Number212. July 2008. Agency for Healthcare Research and Quality, Rockville, MD. Retrieved from http://www.meps.ahrq.gov/mepsweb/data_files/publications/st212/stat212.pdf

Staber, U.H. (1992). Organizational Interdependence and Organizational Mortality in the Cooperative Sector: A Community Ecology Perspective. *Human Relations, 45(11),*1191-1211.

Stagnitti, M. N. (2007). *Trends in outpatient prescription drug utilization and expenditures: 1997 and 2004.* Statistical Brief Number168. April 2007. Agency for Healthcare Research and Quality. Retrieved from http://www.meps.ahrq.gov/mepsweb/data_files/publications/st168/stat168.pdf

Stanton M.W., Rutherford M.K. Employer-sponsored health insurance: trends in cost and access. Rockville (MD): *Agency for Healthcare Research and Quality*; 2004. Research in Action Issue 17. AHRQ Pub. No. 04-0085.

State Health Access Data Assistance Center (2011). State-Level Trends in Employer-Sponsored Health Insurance. Retrieved from http://www.rwjf.org/files/research/72528shadac201106.pdf

Stefanacci, R.G. (2010. Impact of Healthcare Reform on Today's Medicare Beneficiaries—And on Those Who Care for Them. *Clinical Geriatrics, 18(6),* 42-45.

Tabachnick, B.G., & Fidell, L.S. (2001). *Using Multivariate Statistics 4th Ed*. Allyn & Bacon, Needham Heights, MA.

Talley, C.R. (2001). Pharmacist shortage identified by government. *American Journal of Health System Pharmacy. 58(2),* 108-112.

Ukens, C. (2007).. Pay dirt: Pharmacist salaries are still climbing, but at a slower rate. Our exclusive survey shows who gets top dollar Pharmacist salaries. *Drug Topics* Retrieved from http://drugtopics.modernmedicine.com/drugtopics/article/articleDetail.jsp?id=408159

U.S. Census Bureau (2006). *Current Population Survey, 1988 to 2006 Annual Social and Economic Supplements.* Retrieved from http://www.census.gov/hhes/www/hlthins/historic/hlthin05/hihistt4.html

U.S. Census Bureau, Current Population Reports, P60-226, U.S. Government Printing Office, Washington, DC

U.S. Census Bureau. (2008). *Metropolitan and Micropolitan Statistical Areas.* U.S. Department of Commerce. Retrieved from http://www.census.gov/population/www/metroareas/metrodef.html

U.S. Department of Health and Human Services. (2006). *Physician Supply and Demand: Projections to 2020.* U.S. Health Resources and Service Administration Bureau of Health Professions. Retrieved from http://bhpr.hrsa.gov/healthworkforce/reports/physiciansupplydemand/default.htm

U.S. Department of Health and Human Services. (2000). *The pharmacist workforce: A study of the supply and demand for pharmacists.* Rockville MD: U.S. Health Resources and Services Administration Health Resources and Services Administration, Government Printing Office. Retrieved from http://bhpr.hrsa.gov/healthworkforce/reports/pharmacist.htm.

U.S. Department of Health and Human Services (2008). The Adequacy of Pharmacist Supply: 2004 to 2030 Retrieved from http://bhpr.hrsa.gov/healthworkforce/reports/pharmsupply20042030.pdf

U.S. Department of Health & Human Services, (2010). A New Day for Healthcare in America. Retrieved from http://www.healthcare.gov/law/introduction/index.html.

Vandervoet, K. (2007). Walgreens pharmacy cutting its hours due to personnel shortage. *Nogales International*. Retrieved from http://www.nogalesinternational.com/.

Vivian,J. (2010) Healthcare Reform Legislation: Part I. Retrieved from http://www.uspharmacist.com/content/d/pharmacy_law/c/20824/

Walton, S.M., Cooksey, J.A. Knapp, K.K., Quist, R.M. & Miller, L.M. (2004). Analysis of pharmacist and pharmacist-extender workforce in 1998-2000: assessing predictors and differences across states. *Journal of the American Pharmacists Association, 44(6)*, 673-683.

Walton, S.M., Knapp, K.K., Miller, L. & Schumock, G.T. (2007). Examination of State Level changes in the pharmacist labor market using census data. *Journal of the American Pharmacist Association*, 47(3), 348-357.

Wechsler, J. (2010). Healthcare Reform Expands Coverage, Promotes Innovation. *BioPharm International, 23(5),* Retrieved from http://biopharminternational.findpharma.com/biopharm/Regulatory+Compliance+Articles/Healthcare-Reform-Expands-Coverage-Promotes-Innova/ArticleStandard/Article/detail/667243

Weinick, R.M., Byron, Sepheen, C., & Bierman, A.S. (2005). Who Can't Pay for Healthcare? *Journal of General Internal Medicine, 20,* 504–509.

Wholey, D. & Brittain, J. (1986). Organizational Ecology: Findings and Implications *The Academy of Management Review*, 11(3), 513-533..

Wholey, D.R., & Sanchez, S.M. (1991).The Effects of Regulatory Tools on Organizational Populations. *The Academy of Management Review,* 16 (4), 743-767.

Wischnevsky, J.D., & Damanpour, F. (2006). Organizational Transformation and Performance: An Examination of Three Perspectives. *Journal of Managerial Issue*, *18(1)*, 104-128.

Wisconsin Hospital Association, Inc. (2006). *Hospitals Report Pharmacists in Short Supply-New report identifies the five "hardest to fill" hospital positions.* Retrieved from www.wha.org/workForce/pdf/2006workforce_october.pdf.

Woodwell DA. (1997*). National Ambulatory Medical Care Survey: 1996 Summary. Advance data from vital and health statistics*; no. 295.Hyattsville, Maryland: National Center for Health Statistics.

Wuliji, T. (2009). Current status of human resources and training in hospital pharmacy. *American Journal of Health System Pharmacy, 66 (3*), 56-6.

Appendix A

Pharmacy Supply Model Results 1991-2020: Total Active Pharmacists

Year	Active as of Jan 1	Graduates	IPGs	Workforce Losses Due to Estimated Death and Retirement	Net Gain	Total Active Dec 31
1991	NA	NA	NA	NA	NA	NA
1992	171611	7113	314	5664	1763	173374
1993	173374	7380	314	5491	2203	175577
1994	175577	7504	314	5347	2471	178048
1995	178048	7837	314	5240	2911	180959
1996	180959	8003	314	5168	3149	184108
1997	184108	7772	314	5127	2959	187067
1998	187067	7400	314	5084	2630	189697
1999	189697	7829	314	5047	3096	192793
2000	192793	7945	314	5040	3219	196012
2001	196011	7494	314	5101	2707	198718
2002	198718	7485	314	5157	2642	201360
2003	201359	7717	314	5195	2836	204195
2004	204194	7965	314	5230	3049	207243
2005	207243	8054	314	5289	3079	210322
2006	210321	8054	314	5400	2968	213289
2007	213289	8054	314	5486	2882	216171
2008	216171	8133	314	5578	2869	219040
2009	219041	8133	314	5657	2790	221831
2010	221832	8133	314	5756	2691	224523
2011	224524	8213	314	5842	2685	227209
2012	227209	8213	314	5929	2598	229807
2013	229807	8213	314	6004	2523	232330
2014	232330	8293	314	6058	2549	234879
2015	234879	8293	314	6128	2479	237358
2016	237358	8293	314	6203	2404	239762
2017	239762	8373	314	6266	2421	242183
2018	242182	8373	314	6325	2362	244544
2019	244543	8373	314	6385	2302	246845
2020	246844	8452	314	6524	2242	249086

Data Gershon et al., (2000) Study.

Appendix B

NACDS Surveys, 1998 to 2006: Unfilled Positions

Employment Survey Time Series	Vacancies Full-Time of Chain RPh	Vacancies Part-Time of Chain RPh	Total Vacancies
February 1998	2,163	505	2,668
August 1998	2,862	648	3,510
February 1999	3,453	1,024	4,477
August 1999	4,679	1,263	5,942
February 2000	5,971	949	6,920
August 2000	5,546	879	6,425
February 2001	5,723	841	6,564
August 2001	6,666	1,078	7,743
January 2002	5,619	883	6,503
July 2002	4,703	772	5,475
January 2003	4,886	613	5,499
July 2003	3,818	845	4,663
January 2004	3,538	470	4,008
July 2004	3,414	610	4,024
January 2005	4,542	1,420	5,962
July 2005	4,971	1,000	5,971
January 2006	3,941	3,558	7,499
July 2006	4,044	389	4,443

Appendix C

Mean U.S. ADI Values from September 1999 through September 2003

State	Mean ADI	State	Mean ADI	State	Mean ADI	State	Mean ADI
Alabama	4.06	Illinois	4.05	Montana	3.63	Rhode Island	3.13
Alaska	4.05	Indiana	4.12	Nebraska	3.56	South Carolina	4.02
Arizona	4.04	Iowa	3.94	Nevada	3.77	South Dakota	3.42
Arkansas	3.65	Kansas	3.84	New Hampshire	3.79	Tennessee	4.24
California	4.73	Kentucky	4.42	New Jersey	3.57	Texas	4.39
Colorado	3.89	Louisiana	3.75	New Mexico	3.93	Utah	3.86
Connecticut	4.03	Maine	4.09	New York	4.05	Vermont	3.58
Delaware	3.45	Maryland	4.35	North Carolina	4.05	Virginia	4.32
District of Columbia	4.2	Massachusetts	3.82	North Dakota	3.45	Washington	3.98
Florida	4.15	Michigan	4.31	Ohio	4.15	West Virginia	4.22
Georgia	4.05	Minnesota	4.54	Oklahoma	3.8	Wisconsin	4.6
Hawaii	3.1	Mississippi	4	Oregon	3.87	Wyoming	3.73
Idaho	3.61	Missouri	3.92	Pennsylvania	3.94		

Data provided by Knapp et al. (2005)

ADI = Aggregate Demand Index. Ratings are defined as follows: 5 = high demand for pharmacists, difficult to fill positions, 4 = moderate demand, some difficulty filling positions, 3 = demand in balance with supply, 2 = demand is less than the pharmacist supply available and 1 = demand is much less than the pharmacist supply available.

Appendix D

Percentage Change in Number of Hospitals, Insured Population, Population 65+, Pharmacy Facilities, and Number of Physicians Per Year, 1994-2009

Year	Hosp[1]	% Change	Ins[2]	% Change	Pop 65+[2]	% Change	PharmF[1]	% Change	DR[1]	% Change
1994	0	NA	222.4	NA	33.20	NA	0	NA	623.4	NA
1995	6.4	NA	223.7	1%	33.55	1%	68.13	NA	653.7	5%
1996	0	NA	225.0	1%	35.53	6%	70.77	4%	672.6	3%
1997	0	NA	225.6	0%	35.98	1%	72.87	3%	695.9	3%
1998	0	NA	227.4	1%	35.77	-1%	73.31	1%	720.2	3%
1999	0	NA	237.1	4%	36.04	1%	72.03	-2%	735.9	2%
2000	6.3	-2%	240.3	1%	34.99	-3%	73.75	2%	752.2	2%
2001	6.2	-1%	241.4	0%	35.28	1%	72.93	-1%	765.4	2%
2002	6.2	0%	243.1	1%	35.59	1%	74.91	3%	783.4	2%
2003	6.2	0%	244.0	0%	35.91	1%	78.47	5%	802.6	2%
2004	6.3	1%	246.8	1%	36.29	1%	80.85	3%	808.9	1%
2005	6.6	4%	249.0	1%	36.78	1%	87.24	7%	818.8	1%
2006	6.6	0%	249.8	0%	37.25	1%	85.26	-2%	828.0	1%
2007	6.6	0%	253.4	1%	37.88	2%	85.67	0%	844.8	2%
2008	0	NA	255.1	1%	38.86	3%	83.94	-2%	848.9	0%
2009	0	NA	253.6	-1%	39.57	2%	84.81	1%	0	NA

[1] Calculated in 1,000s, [2] Calculated in 1,000,000s

Appendix E

Percentage Change in Pop, Pharmacies Per 100,000, Employers by Size Per Year

Year	Pop[2]	% Change in Pop Per Year	Rx[2]	% Change in Rx Per Year	Pharmacies Per 100,000 population (PharmFC)	% Change in Pharmacies Per 100,000 population Per Year (PharmFC)	Employers with 19 or Less employees (EmpS)[1]	% Change in Employers with 19 or less employees Per Year (EmpS)	Employers with 20 or More employees (EmpS)[2]	% Change in Employers with 20 or more employees Per Year (EmpS)
1994	260.34	NA	0	NA	0	NA	4.11	NA	2.39	NA
1995	262.76	1%	0	NA	27.81	NA	4.18	2%	2.42	1%
1996	265.28	1%	2211	NA	28.40	2%	4.25	2%	2.48	2%
1997	267.60	1%	2290	3%	28.98	2%	4.30	1%	2.59	4%
1998	270.24	1%	2437	6%	28.90	0%	4.33	1%	2.60	1%
1999	272.65	1%	2682	9%	29.62	2%	4.24	-2%	2.58	-1%
2000	281.42	3%	2838	6%	29.52	0%	4.36	3%	2.70	4%
2001	284.79	1%	2974	5%	29.64	0%	4.38	1%	2.70	0%
2002	288.36	1%	3038	2%	29.11	-2%	4.37	0%	2.82	4%
2003	290.80	1%	3083	1%	29.97	3%	4.43	1%	2.82	0%
2004	293.65	1%	3116	1%	30.80	3%	4.50	2%	2.88	2%
2005	296.41	1%	3192	2%	31.08	1%	5.40	17%	2.09	-38%
2006	299.39	1%	3309	4%	33.21	6%	5.42	0%	2.17	4%
2007	301.62	1%	3496	5%	32.37	-3%	5.46	1%	2.23	3%
2008	304.05	1%	3556	2%	32.30	0%	5.34	-2%	2.25	1%
2009	307	1%	3658	3%	0	NA	0	NA	0	NA

[1] Calculated in 1,000s, [2] Calculated in 1,000,000s

Appendix F

Percentage Change in Employer Volume, Hospital Beds Per 100,000, Office based Physicians 100,000, and Median Household Income Per Year

Year	Total Employers (EmpV)[2]	% Change in Employers Per Year (EmpV)	Hosp beds Per 100,000 population (HospC)	% Change in Hosp Beds Per 100,000 population Per Year (HospC)	OBDR Per 100,000 population	% Change in OBDR Per 100,000 population Per Year	Median household income (MHI)	% Change in Median household income Per Year (MHI)
1994	6.50	NA	0	NA	0	NA	$46,399	
1995	6.61	2%	446.8	NA	156.9	NA	$47,255	2%
1996	6.73	2%	0	NA	0	NA	$47,810	1%
1997	6.89	2%	0	NA	0	NA	$48,774	2%
1998	6.94	1%	0	NA	0	NA	$50,661	4%
1999	6.83	-2%	0	NA	0	NA	$51,815	2%
2000	7.07	3%	384.2	-16%	170.3	8%	$52,017	0%
2001	7.09	0%	382.4	0%	177.3	4%	$51,248	-2%
2002	7.20	1%	374.0	-2%	176.7	0%	$50,511	-1%
2003	7.25	1%	367.7	-2%	180.8	2%	$50,648	0%
2004	7.38	2%	363.4	-1%	182.5	1%	$50,529	0%
2005	7.49	1%	360.6	-1%	187.7	3%	$50,771	0%
2006	7.60	1%	357.9	-1%	184.7	-2%	$51,439	1%
2007	7.70	1%	356.0	-1%	183.9	0%	$52,138	1%
2008	7.60	-1%	0	NA	180.3	-2%	$50,583	-3%
2009	0	NA	0	NA	0	NA	$49,857	-1%

[1] Calculated in 1,000s, [2] Calculated in 1,000,000s

Vita

Kevin Shawn Joseph Lett was born on December 6, 1976, in Christiansted, St.Croix, United States Virgin Islands and is an American citizen. He graduated from St. Dunstan's Episcopal School, Christiansted, St.Croix, United States Virgin Islands in 1993. Upon graduation from high school, he moved to the United States to attend college. He received his Bachelor of Arts in Psychology from Hampton University, Hampton, Virginia in 1997. Subsequently he moved to the Washington DC Metro Area, where over the next several years he worked for a managed care organization and the United Mine Workers Association Health Fund. During the course of working for these organizations he enrolled at George Mason University, where he received a Master's of Science in Health Systems Management in 2002. Kevin then transitioned to a position as a Patient Safety Analyst for the Department of Defense in 2003 and continues to work for this organization at this point in time.